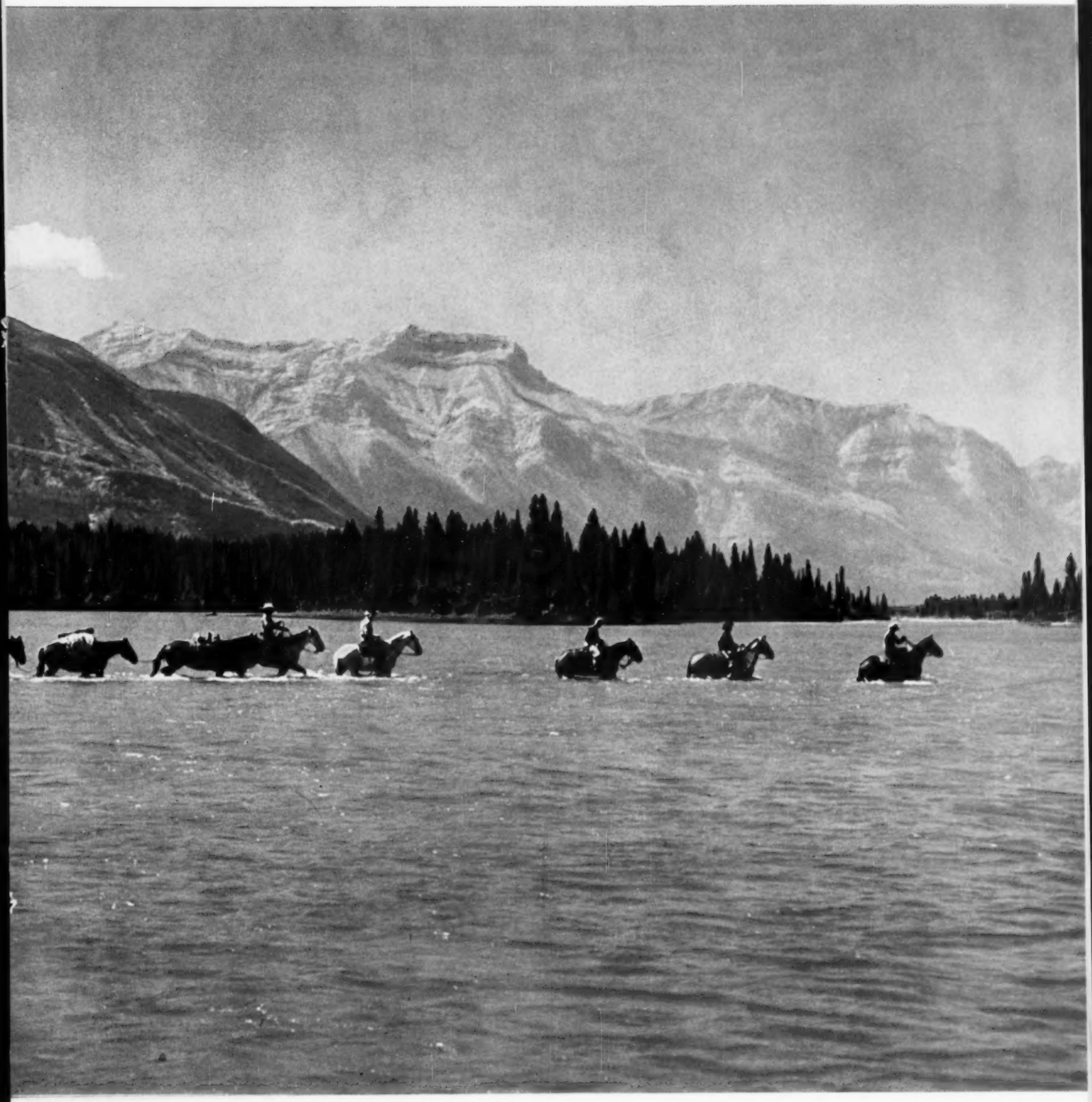
WORLD PETROLEUM

may 1957



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8th Annual Canadian Review Number

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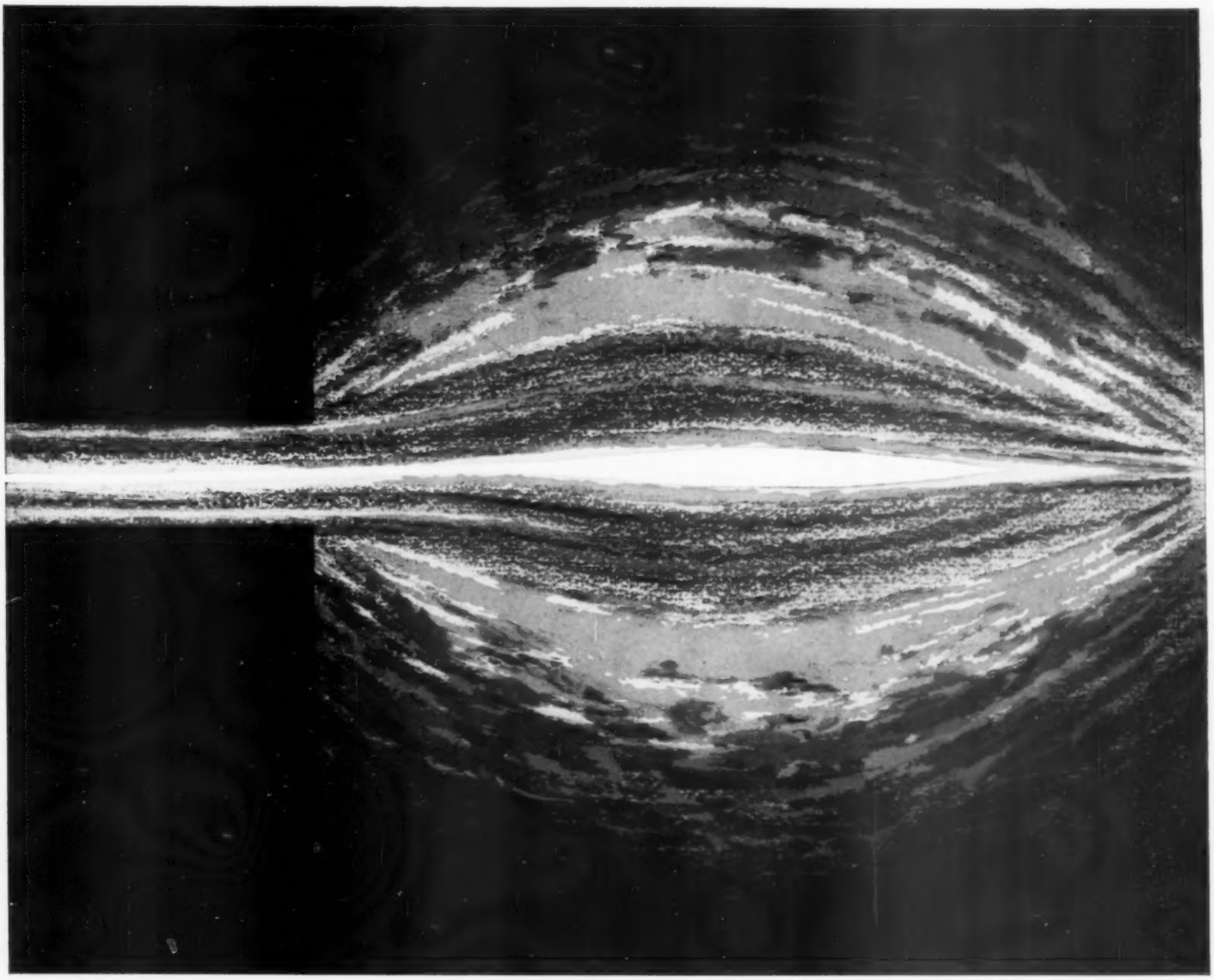

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The technique of steel furnace boosting with a jet of pure oxygen stabilizes quality and batch uniformity.

This principle, whether applied to Open Hearth, Blast or Bessemer, enables manufacturers to widen still further their range of specialized quality steels.

Growing demands of scientific and industrial progress require speedier delivery in the face of increasing competition. It is vital that manufacturers employ this latest technique which shows greater economy and is only made possible by employing the proven principle of the Butterley on-site Tonnage Generator. This compact, efficient plant produced a continuous supply of Oxygen and/or Nitrogen at any desired purity and pressure, piped direct to the point of usage, in the exact quantity desired. Its efficiency eliminates production hold-ups by maintaining a constant supply, and maintenance costs are low.

The Butterley Company have acquired the sole production and sales rights of this, the most successful American Process, for the United Kingdom, British Commonwealth, and certain European countries.

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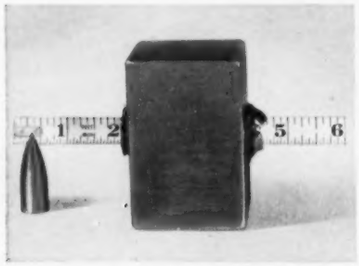

Illustration above shows a 2½" steel test sample pierced by an improved ½" Ogival Bullet fired by a McCullough M-3 Bullet Perforator.

McCullough Sectional Gun Gains Penetration Where Previous Attempt Failed

Depth of operation was only 1487'. 4½" O.D. casing had been cemented in 10¾" hole. Pay zone was bullet perforated by another service company but the formation would not break down. During the attempt to fracture, the pipe split above the zone and collapsed in the perforations.

Operator swaged out the 4½" casing, ran a 3" liner inside the 4½" and cemented the annulus. This operation made an impressive amount of steel and cement to be penetrated to gain production.

McCullough shot 20 improved ⅜" Ogival Bullets in the zone and the formation broke down at 800 lbs. Time on the job was one hour. Results: a good well and a satisfied oil man.

McCullough Sectional Guns are available in 1⅛" O.D., 1¾" O.D. and 2¼" O.D. sizes.

Powerful M-3 Guns Increase Production 316%

Hard Shooting M-3 Guns, Firing Improved Ogival Bullets, Gain 38 B/D Over Previous Jet Perforating

An excellent example of the penetrating power of McCullough M-3 Bullet Guns was recently reported from a California oilfield.

This was a shallow, low production field. The well had previously been perforated by another service company with shaped charges for a settled production of 12 barrels of oil per day.

Productive interval lay between 3837' and 3872' and was cased with special 7" O.D. 51 lb. casing. Casing was cemented in 9¾" hole through the pay zone.

Although skeptical of the ability of any bullet perforator to gain effective penetration through the extra heavy casing and thick cement sheath, the operator called for McCullough M-3 Bullet Guns.

McCullough Service Crew made three runs with 4¾" O.D., 20-shot M-3 Guns, firing 140 improved ½" Ogival Bullets, four per foot, in the 35' zone.

Production increased from 12 to a settled 50 barrels of oil per day—a gain of 38 barrels. The job required two hours, including rigging up and tearing down. To quote the operator, "Results were very satisfactory and gratifying"

"world's hardest shooting bullet perforator"

M-3 Penetrates Two Strings For a Good Well

Two strings of casing had been set through the pay zone at 5587'–5590'. 5" O.D. 18 lb. liner was cemented in 7⅝" O.D. 28 lb. casing which, in turn, was cemented in 11¼" open hole.

A 3½" O.D. McCullough M-3 Gun fired 18 improved ½" Ogival Bullets in the three foot pay zone. Operator stated he is satisfied it is his best completion to date.

Burr-Free Penetration

A new Burrless Bullet Cap, if desired, is inserted over the point of the improved Ogival Bullet at the time the M-3 Gun is loaded. It provides a completely burr-free hole on the inside surface of the perforated casing. Symmetrical, smooth holes make the use of ball sealers more effective in acidizing and sand fracturing—assuring more complete perforation shut-off.

Burr-free holes make casing scraping only a routine, precautionary measure and insure free passage of swabs, packers or other close fitting tools.

The jobs described above are certified to be true and accurate field reports of services rendered.

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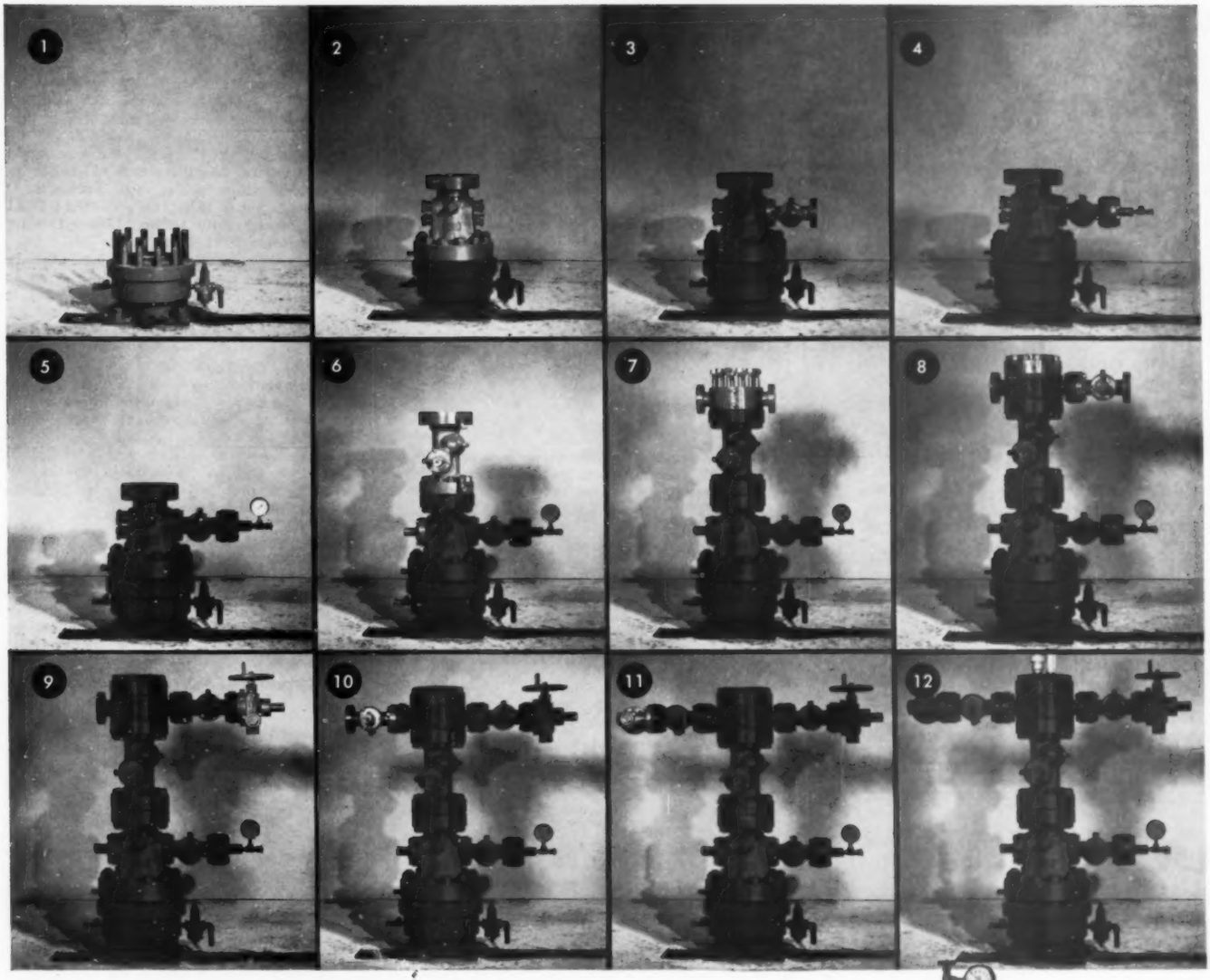
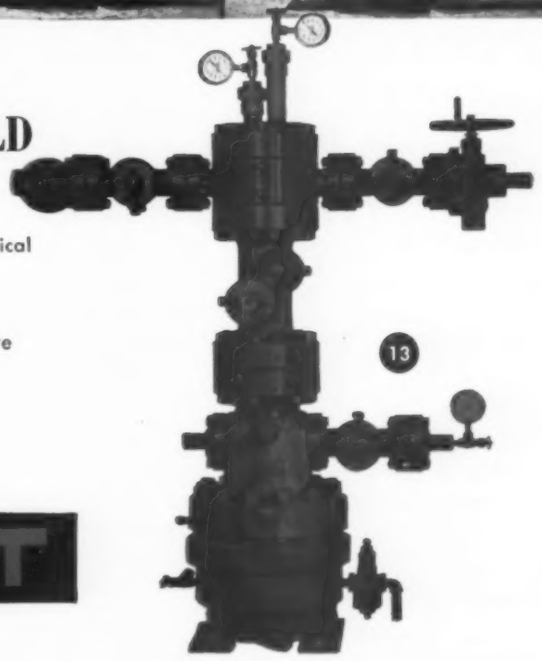


"STEP-BY-STEP STORY" of the BEST DUAL ASSEMBLY IN THE FIELD



From the first bolt to the last gauge, the dual tree shown above in the various stages of growth, represents the most practical and efficient dual well control equipment in the field.
It is an O-C-T Dual Tree, including the new and revolutionary O-C-T Universal Tubing Head.
Dual assemblies, pioneered by O-C-T and now improved to give you even greater versatility, answer long existing problems.
For deep or shallow multiple pay zones . . . if you make **any** kind of dual completion . . . make it O-C-T, the pioneer and leader in dual completion equipment.

OIL CENTER TOOL CO.

Houston, Texas

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Washington PIPE LINE

By Joseph Huttlinger

Prospects for 1957

Midway in the present session of Congress, the oil industry is the center of congressional attention as rarely in the past. Here's a review of the picture:

Oil prices: Senate and House members still do not like the rise in prices, but find little they can do after hearings. After all, costs are up.

Utility controls: These have been suggested, and one bill is in for them, with no chance of passing now. This does indicate concern in Congress over oil price rises.

Depletion provision: This is under attack in several bills, which would slash it to 15% from 27½%. Secretary of the Treasury Humphrey is for no change. Outlook is for no change.

Oil taxes abroad: US companies operating abroad are under fire for paying little or no income taxes to the USA. For instance, senators are making much of the fact that Arabian American Oil Co. earned in 1955 some $272 million net, and paid no US taxes. Suggested are steps to take away the depletion provision for foreign operations. Another is to treat payments to foreign governments as "deductions" for US tax purposes, rather than as direct "offsets."

Mergers: Congress is likely to pass a bill to slow down mergers.

Natural gas: There'll be no effective bill this year to remove federal price controls over independent producers of natural gas. Changes are dim for next year, too. Opposition is strong, despite President Eisenhower's appeal for a bill.

Tankers: Huge tanker-building program is in the works by private capital over the world. Yet, House committee sees failure of "trade-in" program, and too much transfer of US tankers to foreign registry. US officials have dropped plans for a "crash" tanker-building program.

Gasoline marketing: The "good faith" pricing bill, to make it harder for major oil companies to cut the price to dealers to meet competition, faces an uphill fight as majors oppose it. Jobbers are opposed. Many gasoline dealers want it, saying it will help end price wars. Matter is a major one for oil. Compromise legislation may result.

Roosevelt: Gasoline dealers are the subject of nationwide hearings which started in April on three bills by Representative James E. Roosevelt (D., Calif.), for divorcement of oil refining and retail outlets; divorcement of major oil companies from sales of tires, batteries, and accessories; and for a "day-in-court" for gasoline dealers whose leases are canceled. Outlook is the "day-in-court" measure, for one, will pass.

MEEC: Middle East Emergency Committee will drop out of business as soon as possible, when the Middle East oil gets going again in good volume. Congressional studies proved nothing wrong with MEEC, although senators didn't like oil companies getting together in MEEC. Neither, for that matter, did MEEC members.

Pipelines: More of them are being built in the USA as a result of the Suez crisis which pointed up shortages. The Eisenhower administration is smiling on US financial aid for an oil-products line from Beaumont, Texas, to the US East Coast, proposed by Paul Ryan of American Pipe Line Corp., New York.

Antitrust: Oil price rises of January, and "price leadership" in general, are under study by a federal grand jury in Alexandria, Va.—with results expected by summer. Department of Justice asked for the inquiry; and seeks indictment of several oil companies.

Federal Trade Commission: The agency is firing at "predatory pricing" aimed at destroying unbranded gasoline outlets in a case against The Pure Oil Co., Birmingham, Ala. FTC aims to protect Sun Oil Co. dealers in a case of "price discrimination" at Jacksonville, Fla.

Oil for Europe: The crisis is over, with warm weather here; and Middle East oil supply is moving closer to normal. In fact, the congressional hearings into a "lag" in oil for Europe indicated to many that the program was going very well, rather than stalling.

Oil imports: They are on the rise again, but Office of Defense Mobilization is moving to halt the rise under authority of the Reciprocal Trade Agreements Act of 1955. This gives the ODM broad, but vague, authority to limit imports when national security is likely to suffer.

Alaska: Bills to open up Alaskan coastal areas (tidelands) are being pushed by Alaskans and oil men, but they face uphill fight. Secretary Seaton drags his feet on order opening the Gubic oil fields to private oil companies, although Alaska and oil companies want this. Seaton is afraid of political charges of "giveaway."

Military land demands: The House Interior Committee has approved legislation to raise a "go slow" sign on military withdrawals of public lands. The full House is expected to pass the measure. Chances are the Senate will be friendly. The measure also forbids the Defense Department to set up and operate new petroleum reserves without specific direction from Congress.

Oil Imports

President Eisenhower has authorized investigation into whether crude imports threaten national security. Planned imports for latter half of 1957 would equal 17.4% of estimated domestic production. The 1954 ratio of 10.34% is widely favored.

Divorcement Before Small Business Committee

Representative James Roosevelt (D., Calif.) is asking oil companies searching questions as he plugs for his two divorcement bills. One would forbid refiners to sell at retail, but Mr. Roosevelt explains he would allow oil jobbers, who are wholesalers, to sell at retail. The other would forbid refiners to sell tires, batteries, and accessories at their outlets. As chairman of a House Small Business Subcommittee, Mr. Roosevelt is hearing from US antitrust officials, all major oil companies, oil jobbers, and gasoline retailers in hearings from one end of the country to the other. Hearings began April 11, and will continue for months.

In the TBA field, he is asking about contracts between oil and tire companies, the volume of business in TBA by companies, and if any of the dealers sell TBA items not sponsored by the major oil companies. About dealers, Mr. Roosevelt is asking about the types of agreements between companies and the dealers, and whether company stations are designed to set the price of gasoline. He wants to know about failures and lease cancellations. Margins which are proper for dealers are being asked about, as well as steps taken by oil companies to maintain fair margins, particularly in price-war cases. Finally, Mr. Roosevelt is asking for any ideas, better than the divorcement bills, to cure the problems of gasoline dealers.

"Good Faith" Measure Opposed

President Eisenhower is likely to veto S. 11, the controversial "good faith" pricing bill, if the Congress passes the measure and sends it to him. Evidence of this lies in a letter opposing the measure from Deputy Attorney General William P. Rogers to the Senate Judiciary Subcommittee. At the bottom, the latter says, "The Budget Bureau has advised that there is no objection to the submission of this report." The Budget Bureau is a traffic cop for US agencies reporting to Congress on proposed bills. When the bureau has no objection, it means views of the agency are not out of line with administration policy.

On the other hand, the Federal Trade Commission, which supports the measure by three to one, as "more good than bad," says in its report that it did not clear with budget. Asked why, commissioners said they did not have time. This sounded lame to senators, for the matter has been up for

(Continued on page 154)

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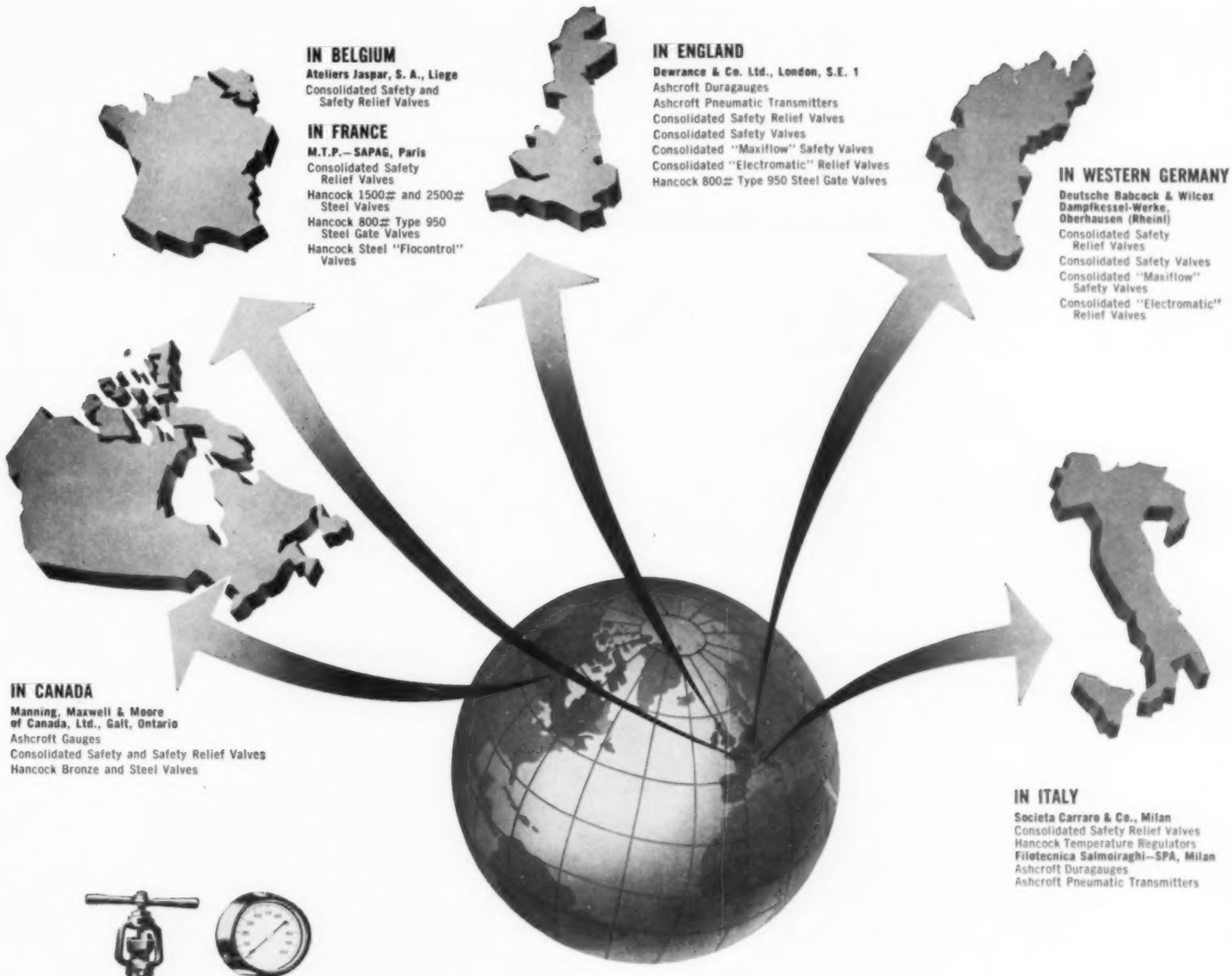

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Consolidated Safety and Safety Relief Valves

IN FRANCE
M.T.P.—SAPAG, Paris
Consolidated Safety Relief Valves
Hancock 1500# and 2500# Steel Valves
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Ashcroft Pneumatic Transmitters
Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves
Hancock 800# Type 950 Steel Gate Valves

IN WESTERN GERMANY
Deutsche Babcock & Wilcox Dampfkessel-Werke, Oberhausen (Rheinl)
Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves

IN CANADA
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Ashcroft Gauges
Consolidated Safety and Safety Relief Valves
Hancock Bronze and Steel Valves

IN ITALY
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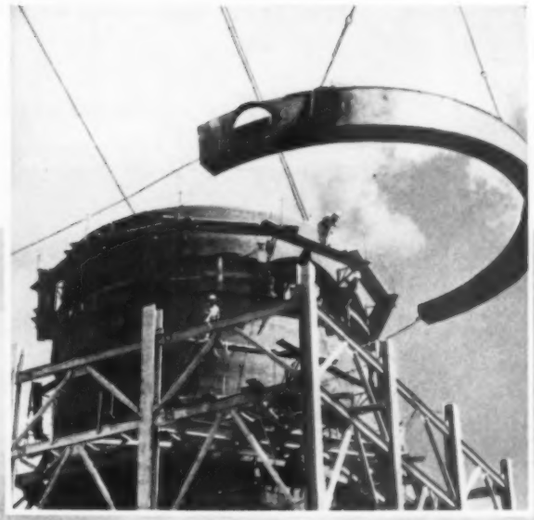

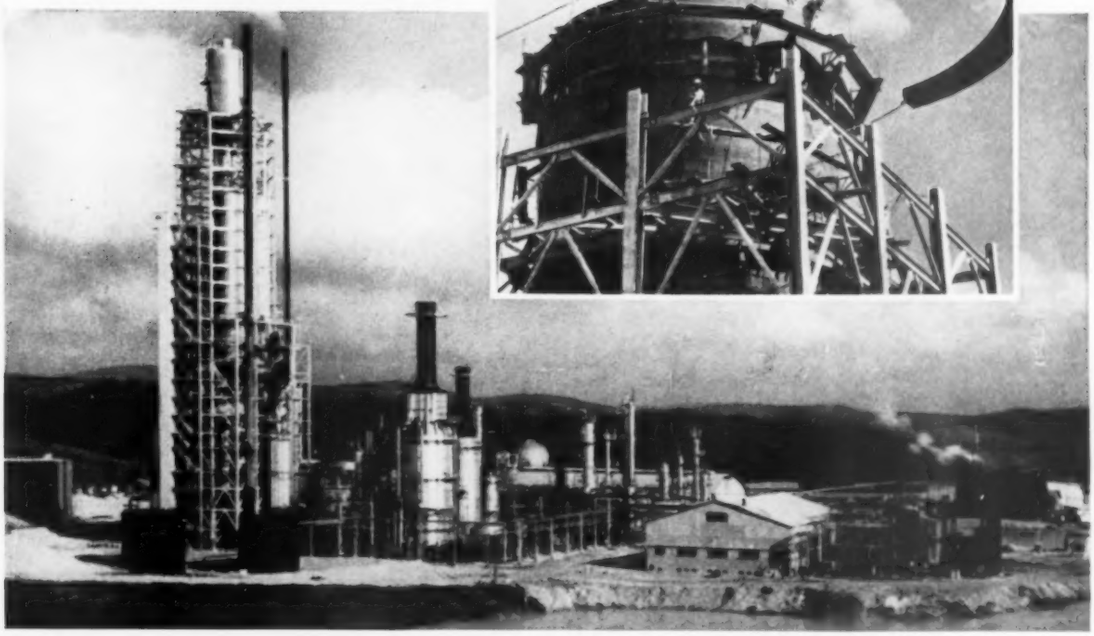

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Top: An air duct section for the TCC kiln being raised into place.

Bottom: General view of Capuava Refinery.

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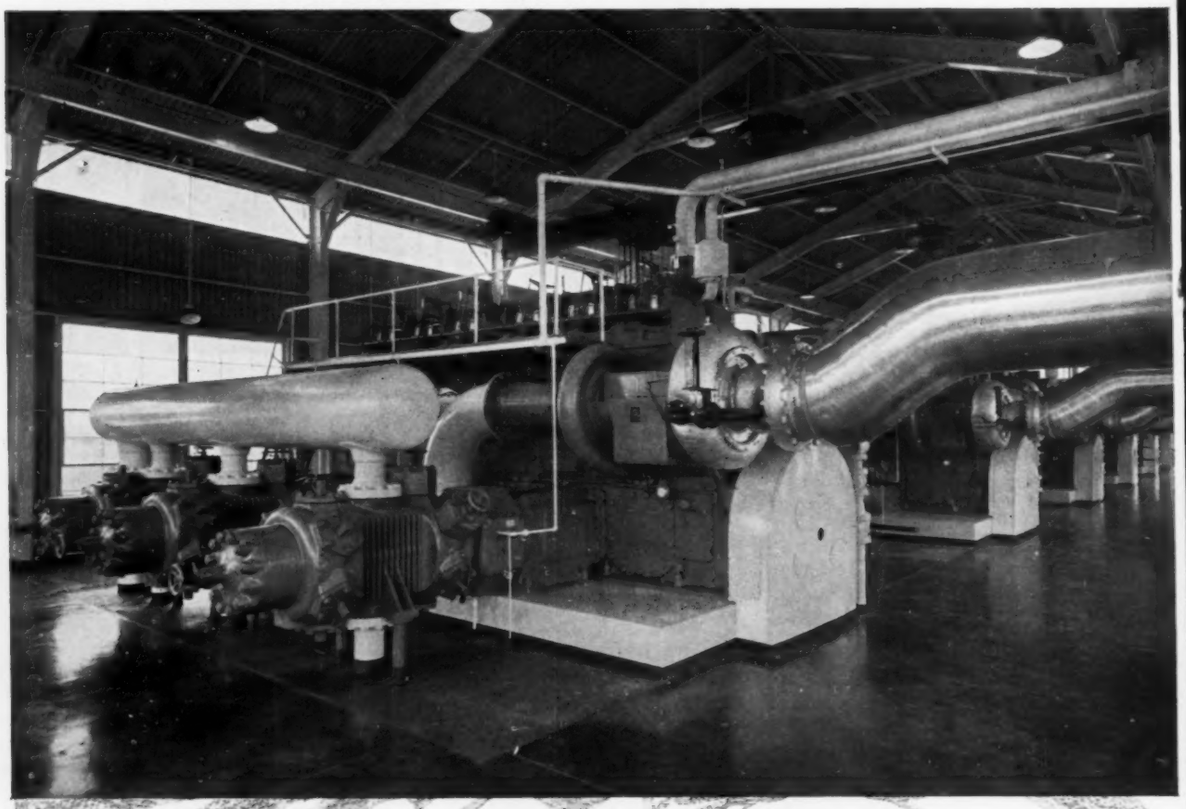
For Pacific Northwest's...

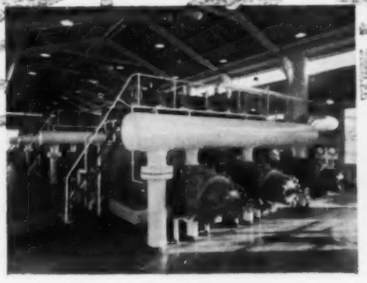
Altitude: 6600'

Station-1. Ignacio, Colorado
Six—2000 bhp. Clark TLA-6 Turbo-supercharged Compressors



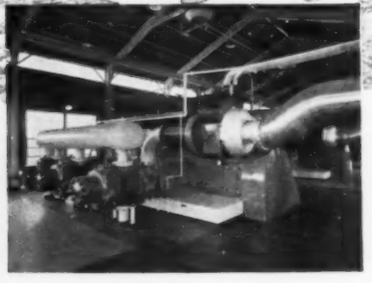
Altitude: 5620'

Station-2. Moab, Utah
Four—2000 bhp. Clark TLA-6 units



Altitude: 6000'

Station-4. Rangely, Colorado
Four—2000 bhp. Clark TLA-6 units



Mile high pipeline

46,000 BHP. of Clark Turbo-supercharged Compressors Furnish Over Half the Main Line Horsepower

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With stations operating at elevations of up to 6600′, normally aspirated engines would have required heavy deration. The Clark TLA-6 units, however, operate with substantially less deration because they are turbo-supercharged. (Clark can now supply for its TLA units, as optional equipment, a special turbocharger for high altitude applications which permits sea level ratings. No deration is required.)

Mountain top locations or "down in the flats", the modern Clark turbo-supercharged compressor is the most economical prime mover to install on today's pipelines. They are built in seven sizes ranging from 1100 to 3400 bhp. Your nearest Clark representative will be pleased to give you complete information.

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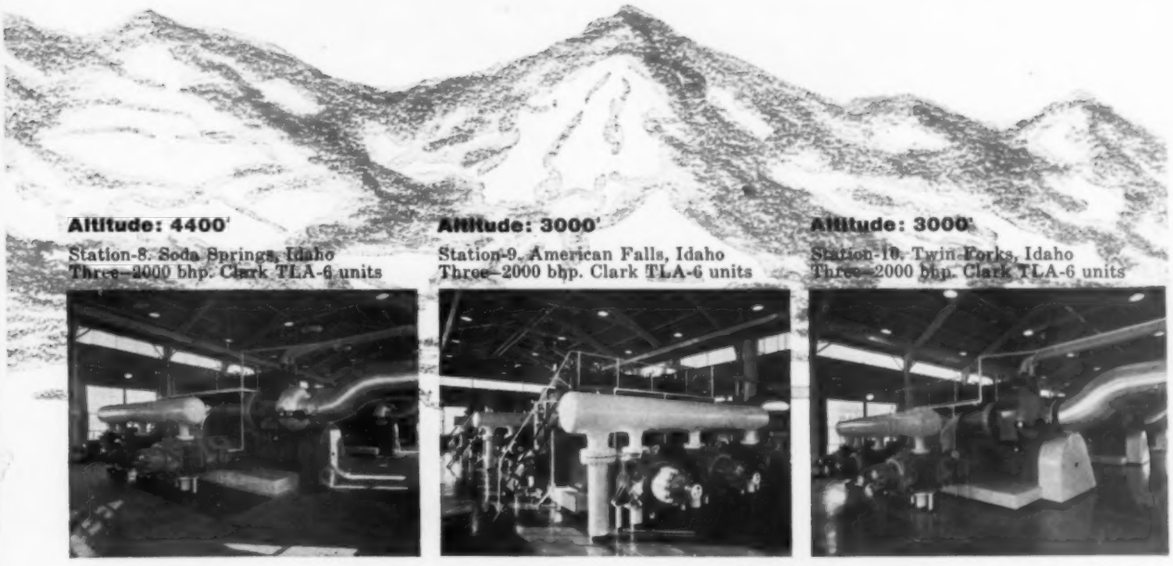

Altitude: 4400′
Station-8. Soda Springs, Idaho
Three—2000 bhp. Clark TLA-6 units

Altitude: 3000′
Station-9. American Falls, Idaho
Three—2000 bhp. Clark TLA-6 units

Altitude: 3000′
Station-10. Twin Forks, Idaho
Three—2000 bhp. Clark TLA-6 units

NOTE: All horsepower ratings are based on sea level elevation.

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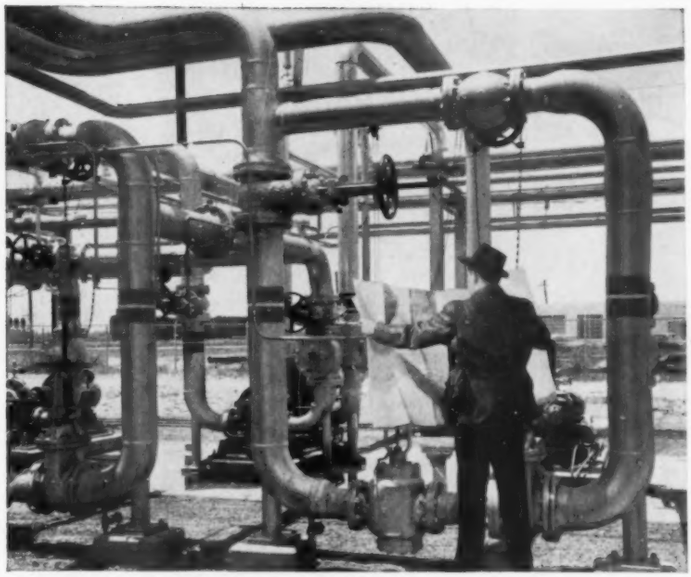

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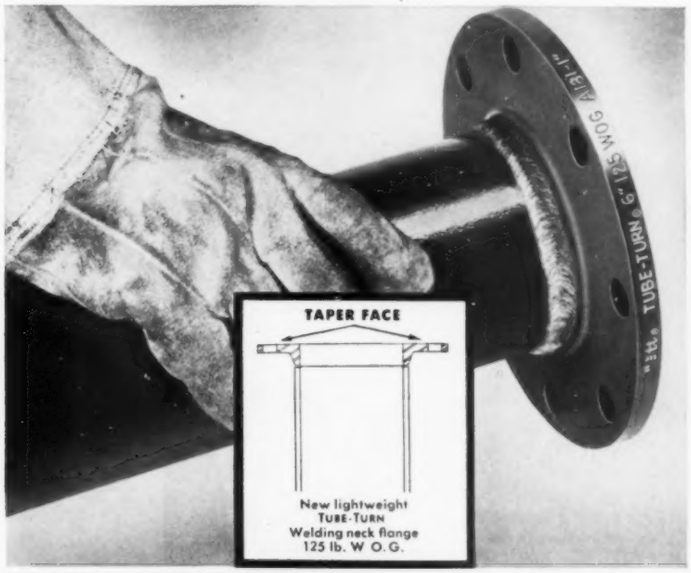

ADVANCED PRODUCT DESIGNS . . such as the new TUBE-TURN Taper Face Welding Neck Flange. This lightweight flange for 125-lb. W.O.G. service cuts cost of low pressure distribution lines, affords effective seal, protects low pressure valve flanges from cracking.

PROMPT SERVICE! Your nearby Tube Turns' Distributor can supply you promptly. One order takes care of all your needs... no shopping around... less red tape. He makes available Tube Turns' engineering service on piping problems.

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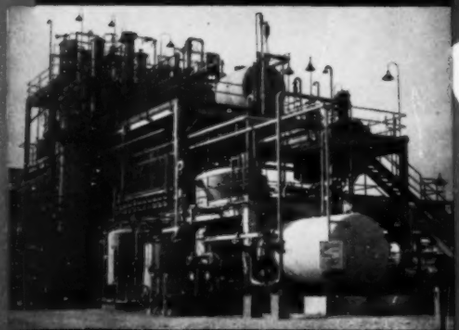
DROP FORGED STEEL

valves, fittings and flanges by Vogt

REFINERIES



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POWER PLANTS

USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

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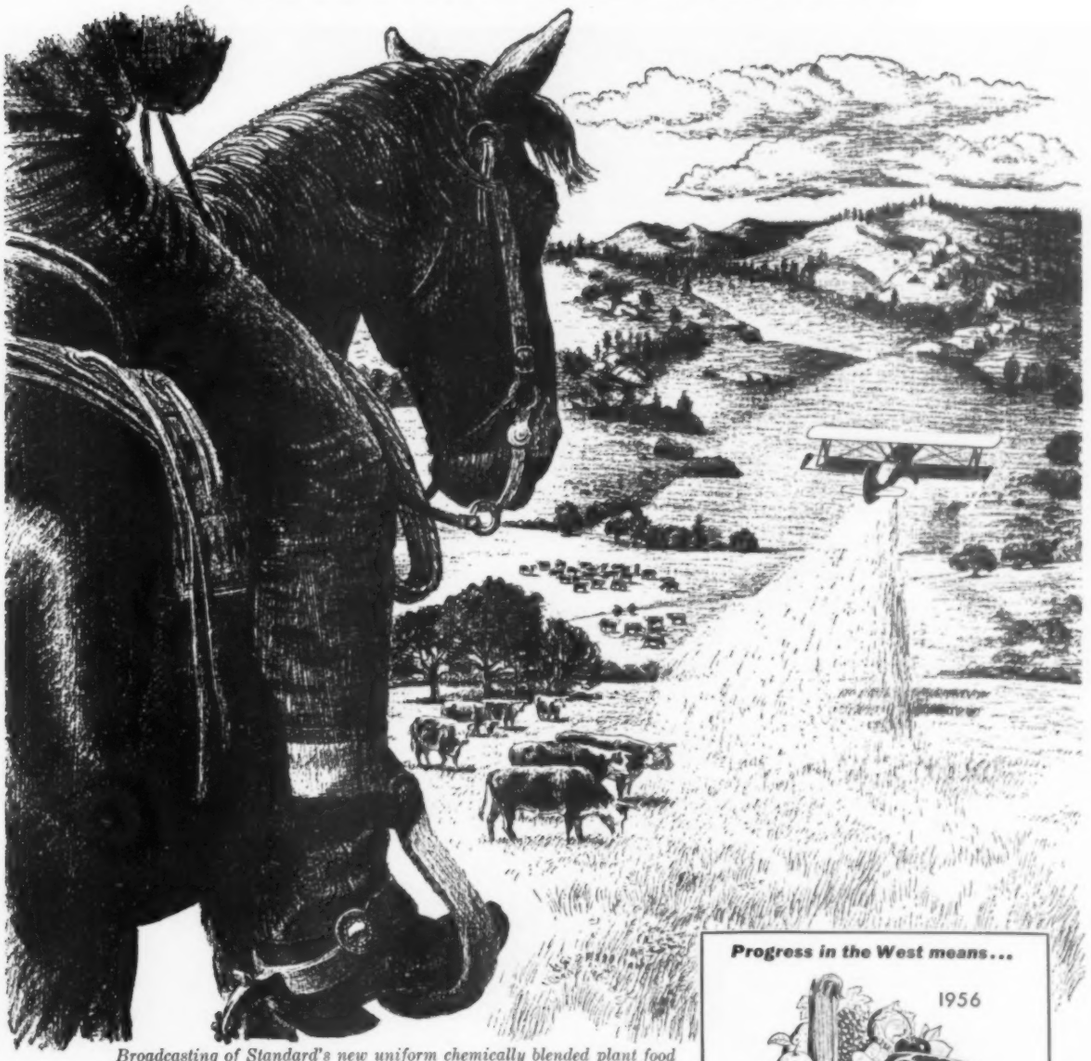
HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., Cincinnati

New Standard plant foods help the West produce better meals at less cost



Broadcasting of Standard's new uniform chemically blended plant food by airplane can turn sparse hilly acres into rich pasture for livestock

Progress in the West means...

food production must increase 35% to feed the 26½ million people who'll live here by 1965

RICHER SOIL means better crops, yet the West has never had enough soil-building fertilizer. To help meet farmers' needs, Standard opens a $16 million plant next month which will produce petroleum-derived plant food* in pellet form for Western soils and crops.

This uniform blend of essential plant growth elements is so effective that 400 pounds on an acre of grassland often enables it to feed 3 to 5 times more livestock. On other crops, too, it increases profits per acre. With this better use of Western land, your family will get tastier, more nourishing meals for every budget dollar.

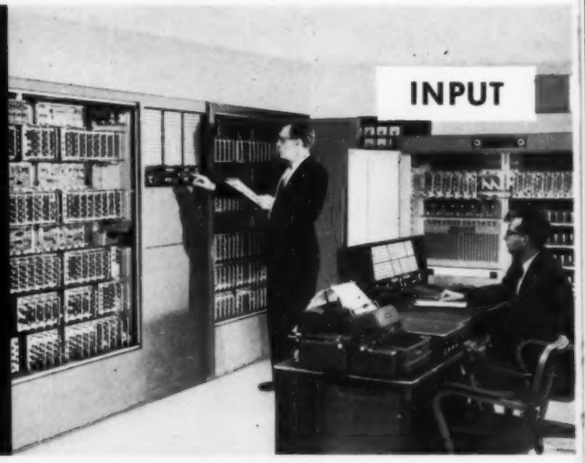
**One of many ORTHO PLANT FOODS, made and sold by Standard's wholly-owned subsidiary, California Spray-Chemical Corp.*

STANDARD OIL COMPANY OF CALIFORNIA

puts petroleum progress to work for you

Kellogg's Faster Route to

Electronic Computer Enables Kellogg Engineers to Study and Evaluate Greater Number of Refinery Design Alternates



Control section of Kellogg's computer

IN DESIGNING heat-pressure process equipment, the addition of a large magnetic drum digital computer to M. W. Kellogg's facilities enables the company's engineers to study variables and produce results with unprecedented thoroughness, accuracy, and speed. Human error is practically eliminated.

To Kellogg's customers in the petroleum and chemical industries, this new electronic aid means that Kellogg engineers can devote more time to basic design problems, and provide equipment with maximum operating efficiency, minimum maintenance costs, and the lowest possible initial investment.

In the case of heat exchangers, for example, design calculations require a trial and error solution. The time required to do this with hand calculations seldom permitted several design alternates. Thus the engineer never could be sure that the design selected was the true optimum. With high speed electronic computation, however, the greater number of alternates economically possible now brings the ultimate or near ultimate design to every Kellogg customer.

In one instance recently, involving 37 heat exchanger shells, the greater number of calculations achieved with the electronic computer resulted in reducing total heat transfer surface requirements by more than 15% from estimated values. Without the computer, the time required to obtain this value would have outweighed the saving many times, and would have been prohibitive.

Kellogg welcomes the opportunity to put its electronic computer and other engineering facilities to work for you. Arrangements to see the computer in operation in Kellogg's New York office can be made by contacting the company's Refinery Process Division.

Refinery Process Division

THE M. W. KELLOGG COMPANY

711 Third Avenue, New York 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

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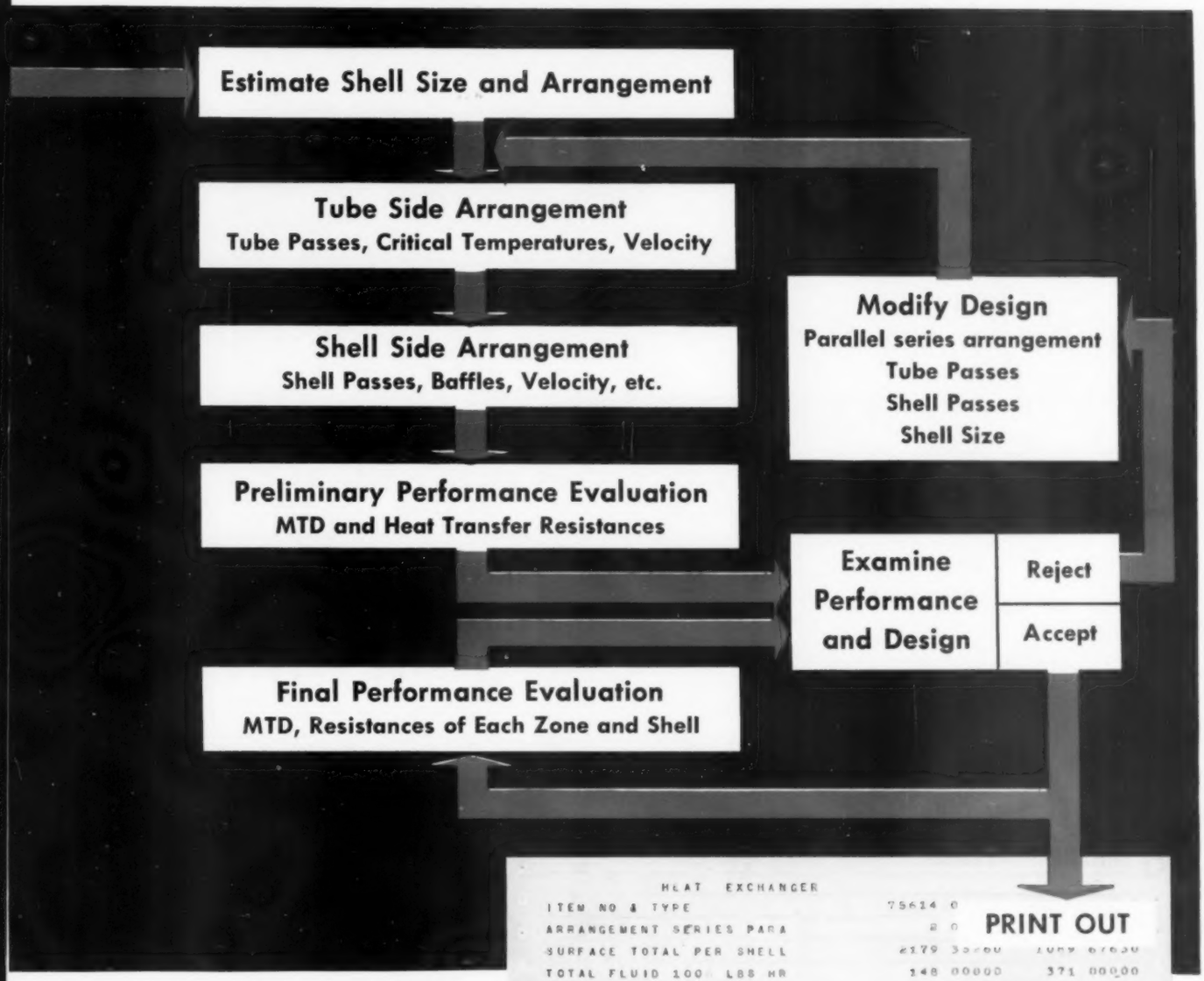
Optimum Refinery Design

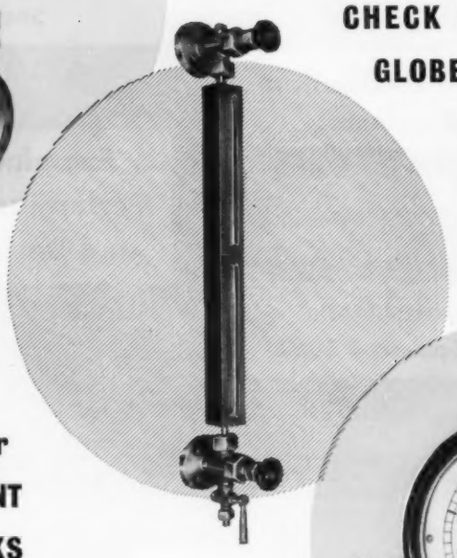


HEAT EXCHANGER

ITEM NO & TYPE	75614	0		
ARRANGEMENT SERIES PARA	2	0		
SURFACE TOTAL PER SHELL	2179	33480	1089	67630
TOTAL FLUID 100 LBS HR	148	00000	371	00000
SP GRAVITY LIQUID		87620		87620
TEMP VISCOSITY F CS A	53130	01306	53130	01706
TEMP VISCOSITY F CS B	53300	01102	53300	01205
TEMPERATURE HOT	300	00000	350	00000
TEMPERATURE COLD	130	00000	286	00000
TUBE PASSES PER SHELL		00000	2	00000
PRESS DROP ALLOW PSI	10	00000	15	00000
PRESS DROP CALCD PSI	9	96988	11	26021
FOUL RESIST A TUBE DIAMTR		00004	1	00000
DUTY MM BTU HR & MTD WTD	13	30000	M7	64713
TOTAL RESIST SERVICE CALCD		01436		01163
DESIGN PRESSURE PSI	150	00000	300	00000
TUBE NUMBER AND LENGTH FT	212	42078	20	00000
SHELL INS DIAM BAFF PITCH		000	8	81250

Here is an example of the computer's work. This liquid-liquid heat exchanger design flow sheet shows the route taken by Kellogg's electronic computer to obtain optimum design results. The boxes shown at right indicate the "detours" taken by the machine to obtain alternates physically impossible or economically prohibitive by hand. Photograph at right is of a partial tabulation, showing how the computer presents results.

VALVES AND FITTINGS FOR THE OIL AND ALLIED INDUSTRIES



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DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry — MAY 1957

NEW DIRECTOR OF SALES FOR PETROLEUM CHEMICALS

W. SAM CARPENTER, III, has been appointed to succeed David H. Conklin as director of sales of the Du Pont Petroleum Chemicals Division. Mr. Carpenter was promoted to this position from that of assistant director of sales.

Mr. Conklin has been named managing director of the Du Pont Company (United Kingdom) Limited. He plans to make his home in London next year.

Alfred R. Mullis, formerly Eastern regional manager of the Petroleum Chemicals Division, replaces Mr. Carpenter as assistant director of sales.

Mr. Carpenter came to the Petroleum Chemicals Division in 1955 from the Cellulosics Division of the Textile Fibers Department where he was director of manufacturing. Prior to joining Textile Fibers, he had been manager of the Du Pont Industrial Engineering Division. He joined the Du Pont Company in 1938 as an industrial engineer.

In 1944 and 1945, he was active in the construction and operation of the government's atomic energy project at Hanford, Washington. Mr. Carpenter received his chemical engineering degree from Princeton University.

Mr. Conklin, who came to Du Pont as a sales-service representative from Ingersoll-Rand, has been with the Petroleum Chemicals Division since it was organized. He was promoted to West Coast regional manager, then to sales pro-

OVER

Refiners can use these marketing services profitably

The Du Pont Petroleum Chemicals Division offers a wide range of marketing aids and services. Many of these are ideal for dealer meeting programs. Others can be profitably used in promotion campaigns. Here is a brief résumé of the Du Pont marketing services now available to you:

MOVIES available from Du Pont make ideal program material for your dealer meetings.

"When the customer says 'KNOCK'" is a Du Pont sponsored, full-color motion picture to instruct dealers on how to handle, in a salesmanlike way, customer complaints about gasoline quality.

This is but one of a series of films. They cover subjects ranging from gasoline quality, just mentioned, to an explanation of the benefits to the public of the percentage depletion allowance. Folders describing these films in detail, along with information on borrowing them, can be obtained from any of our sales offices.

Special demonstration equipment

To help refiners explain quality features of their products clearly and graphically, we have designed and built a number of special demonstration devices. The latest is a machine for showing how carburetor icing occurs and can be prevented with Du Pont dimethyl formamide.

I. T. Rosenlund is shown here operating the de-icing demonstration.

This equipment is ideal for pointing up convincingly your product-quality

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT *Petroleum Chemicals* NEWS

Du Pont equipment and experience usually available to refiners

REFINER:
Yes, we anticipated that fuel injection systems in cars would raise some new problems in gasoline blending . . .

DU PONT REPRESENTATIVE:
That's right, and our Petroleum Laboratory has already been making road tests using special fuels in injection systems.

REFINER:
Is that so – then maybe you people already have some data we could use?

DU PONT REPRESENTATIVE:
We're accumulating it gradually. We have three fuel-injection cars in our Petroleum Lab.

REFINER:
Good! I hope we can get the results of your investigations.

DU PONT REPRESENTATIVE:
I'll see that you do. As our road tests develop further facts we'll keep you informed.

CONTINUED ***Marketing Services***

features to dealer and customer groups.

We can also supply you with a great variety of booklets and visual presentations on gasoline and motor oil quality, customer relations, station services, and other subjects. You can obtain these in large quantities at cost, or at no charge if you'd like only a few copies.

Continuing market surveys

When planning promotion campaigns, you can make use of the findings of our several extensive surveys of customer buying habits and service station operations.

These cover such subjects as the factors influencing a dealer's success, why motorists buy the brands they do, how they select service stations, and which factors in gasoline-brand advertising influence them most.

A report on our latest – and perhaps most important – survey will be finished by mid-summer. The results will be made available to all marketing executives in the oil industry.

Public relations aids

Our newest presentation emphasizes the importance, to everyone, of the petroleum industry – "A 'Brief' Case for Business." It is a lightweight kit which enables you to tell a forceful public relations story in a dramatic way. This kit was conceived and developed by Du Pont and is made available to oil companies through the Oil Information Committee of API, or through your Du Pont representative.

You can probably save time and money by supplementing your own promotion program with these useful aids, adapting them to your own purposes. Any of our Petroleum Chemicals Division representatives or sales offices will be glad to give you more information on them.

continued middle next column

H. C. Thompson displays the "Brief" case public relations kit.

CONTINUED ***New Director of Sales***

motion manager, later assistant director and then director of sales.

Conklin a Navy veteran

During World War II, Mr. Conklin as Commander U. S. Navy, was on active duty 5 years – most of the time in the North Atlantic. He was awarded the Order of the British Empire.

Mullis former sales representative

Alfred R. Mullis joined the Du Pont Company in 1947 as a sales representative in the Gulf Coast Region. He was appointed regional manager there in 1951. The following year he went to New York as Eastern regional manager.

After graduating from Rice Institute with a chemical engineering degree, Mr. Mullis was associated with the Humble Oil and Refining Company in research and development work. While an officer in the Navy from 1942 to 1946, he specialized in petroleum inspection work.

SALES OFFICES

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Cleveland 15–25 Prospect Ave. . . . SUperior 1-1363
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Houston 2–
705 Bank of Commerce Bldg. . . . . CApitol 5-1151
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1270 Ave. of the Americas . . . . . COlumbus 5-2342
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Seattle 3–4003 Aurora Ave. . . . . MElrose 6977
Tulsa 1–1811 So. Baltimore Ave. . . . . LUther 5-5578
In Canada–Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**–Ontario . . . . . HUdson 1-6461
In Other Countries–Petroleum Chemicals Division, Export Sales, 7496 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

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OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-4310

Printed in U. S. A.

there's a touch of imagination in every good construction job

Brains, experience, technical skills, are all fundamental qualities in a good builder. These we have here at Procon in full measure. But, we try to add that vital touch of imagination that helps us visualize the correct answer to exacting new problems and enhances our ability to get each project completed to schedule and to every requirement.

Anywhere in the world, Procon offers the oil refining, petrochemical and chemical industries a complete construction service. Whatever your requirements, from complete new plant construction to expansion, modernization or the addition of process facilities, let us talk them over with you. This is the first step to a job completed to your full satisfaction.

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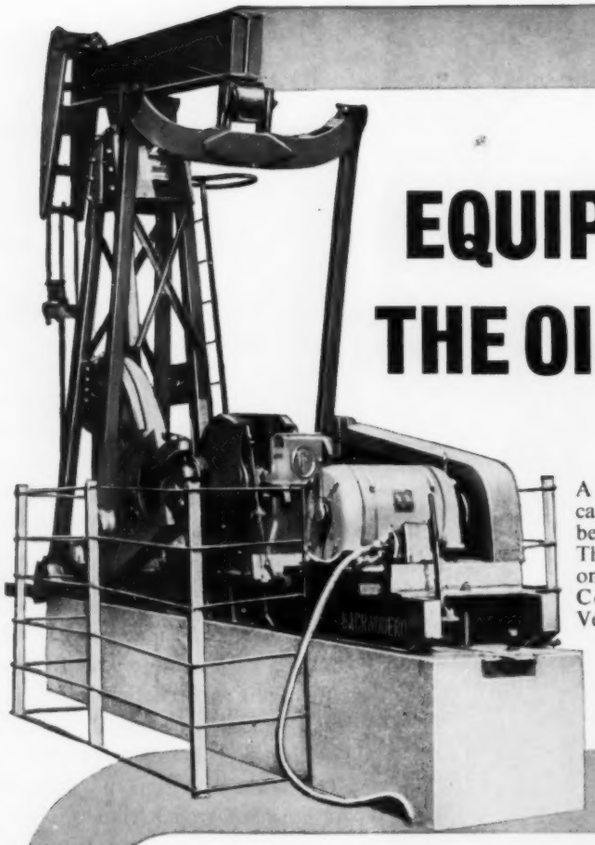
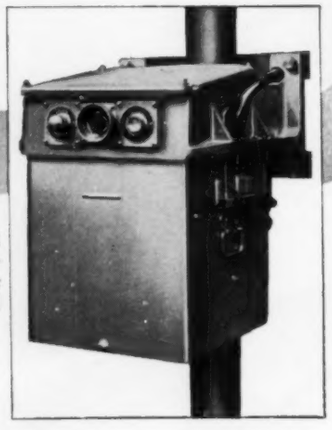
PROCON ®

EQUIPMENT FOR THE OIL INDUSTRY

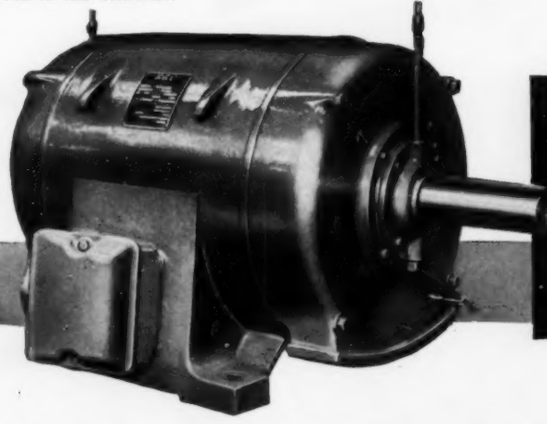


A high torque squirrel cage motor driving a beam type well pump. This installation is on one of the oilfields of Compania Shell de Venezuela.



A combined circuit breaker and contactor starter for the automatic control of oilwell motors.

A G.E.C. weatherproof motor designed and built for arduous work in the oilfields.



BY G.E.C.

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Behind the Ships that Set the Pace . . .
a Master's Touch in Oil

World's mightiest ship, the Navy's newest ocean-going airfield—U. S. S. Saratoga . . .

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All the Atlantic Blue Ribbon Winners, from the Mauretania to the S. S. United States . . .

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The race horses and the work horses of the seas have one thing in common—SOCONY MOBIL'S *master touch* in lubrication.

Good reason! When the chips are down—when records are at stake—when schedules must be met—the men who know marine machinery look to SOCONY MOBIL for its protection.

* * *

Wherever there's progress in motion—in your car, your ship, your plane, your factory, your farm or your home—*you, too, can look to the leader for lubrication.*

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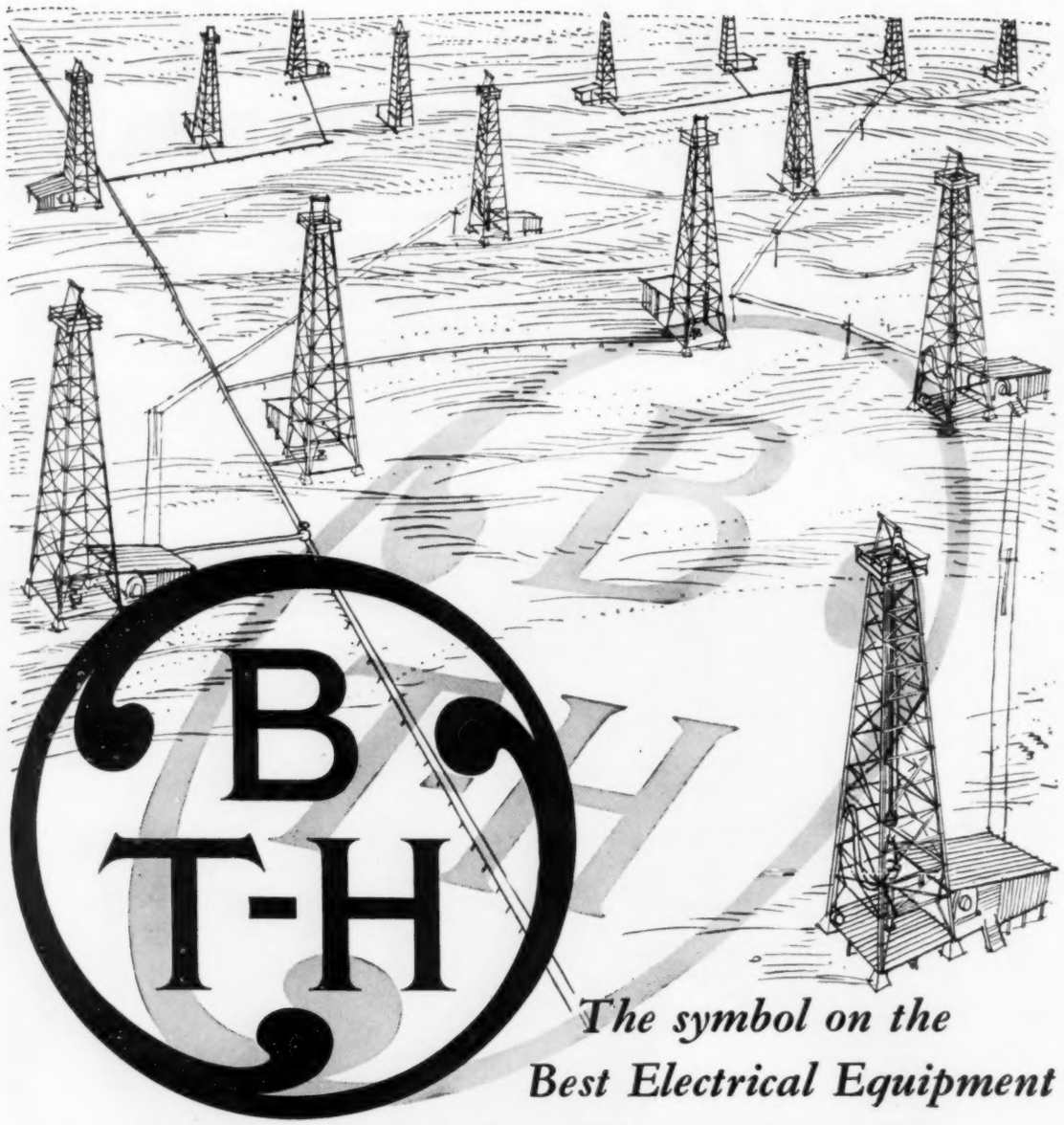

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But this is only one direction in which the specialisation and long experience of BTH have built up an enviable reputation. It is the same in mining, power supply, traction, marine engineering, and general industry—wherever first-class electrical products are needed. With over fifty-four years' experience and eleven factories, BTH can give outstanding service to industry in every sphere of electrical engineering.

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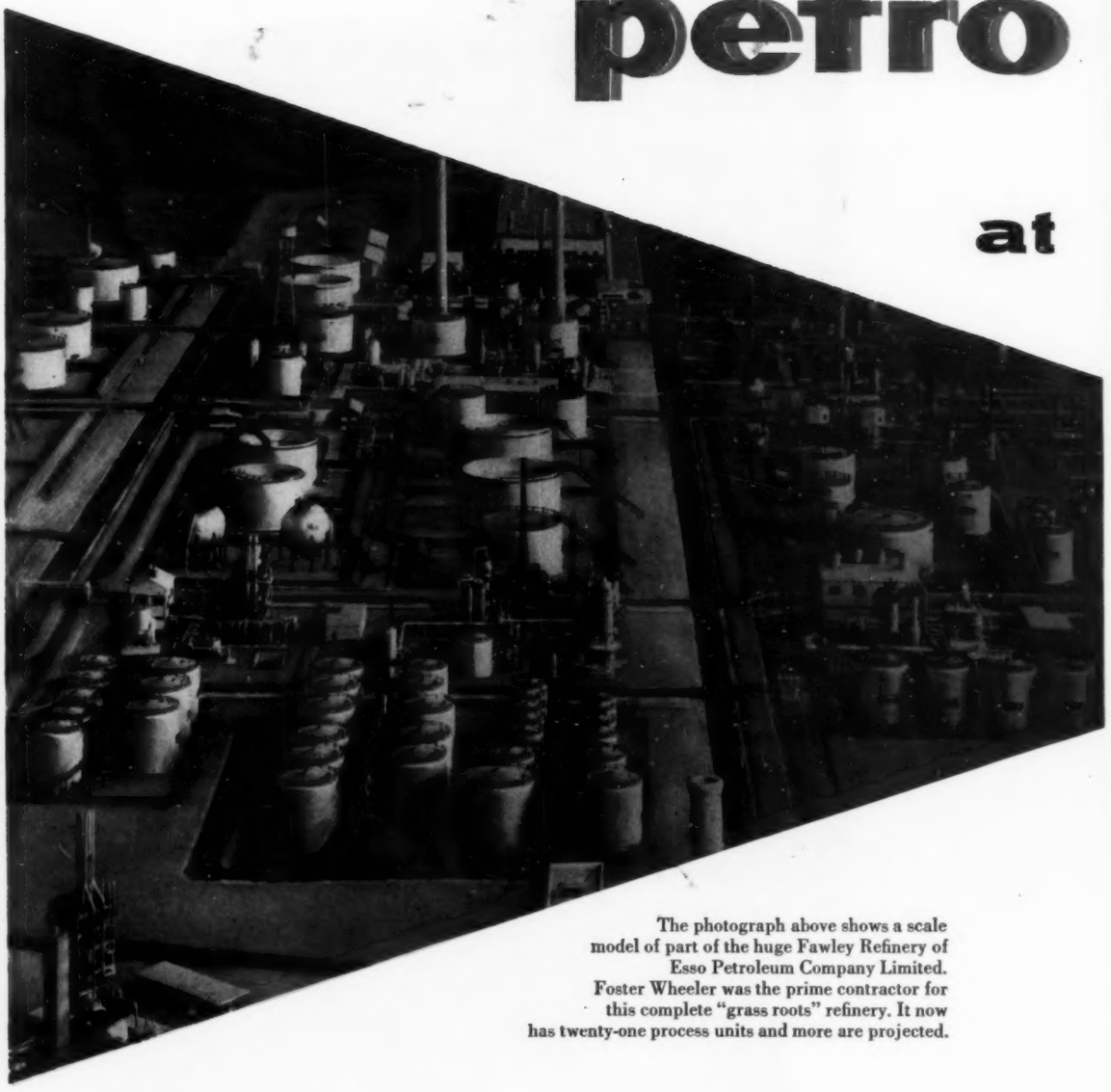

The photograph above shows a scale model of part of the huge Fawley Refinery of Esso Petroleum Company Limited. Foster Wheeler was the prime contractor for this complete "grass roots" refinery. It now has twenty-one process units and more are projected.

• FOSTER WHEELER DESIGNS AND BUILDS

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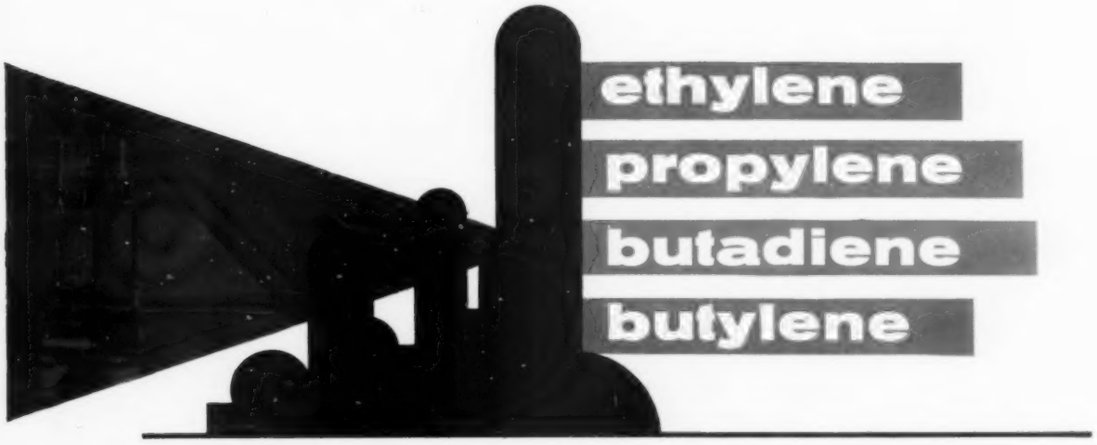

NEW PETROCHEMICAL PLANT for England's Largest Refinery, will be designed and built by Foster Wheeler

SYNTHETIC rubber and plastic hydrocarbon raw materials (ethylene, propylene, butylene and butadiene) will be produced from 250,000 tons per year of petroleum intermediates in a major process installation at the Fawley, England, refinery of Esso Petroleum Company Limited. Foster Wheeler, who built the new Fawley petroleum refinery, the largest in England, will also provide mechanical design and construction for this petrochemical project. Esso Research and Engineering Company supplied basic process design data.

These basic hydrocarbon products represent a new and very substantial source of raw material for the British synthetic rubber and plastic industries.

Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

WHEELER

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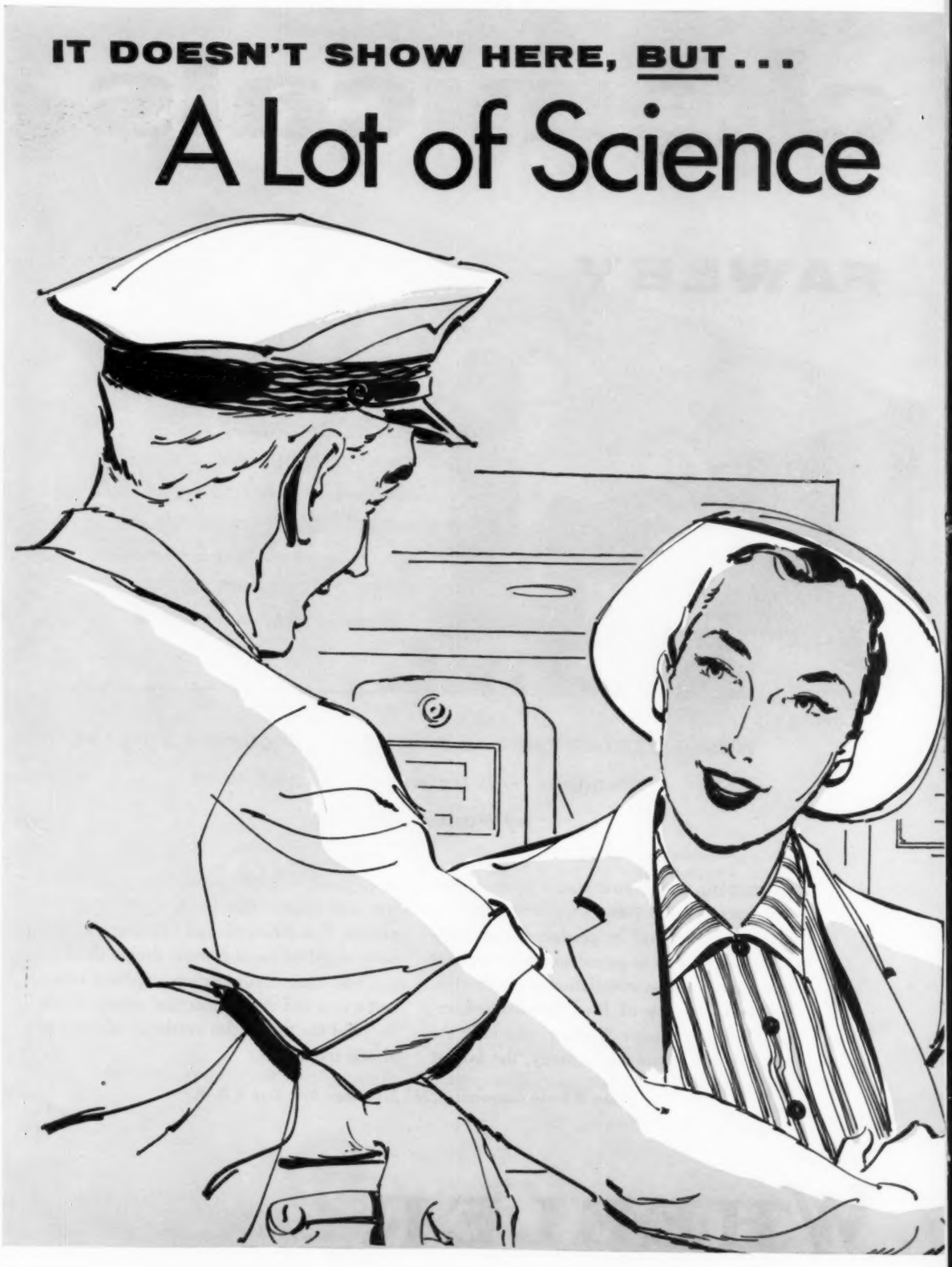
IT DOESN'T SHOW HERE, BUT...

A Lot of Science



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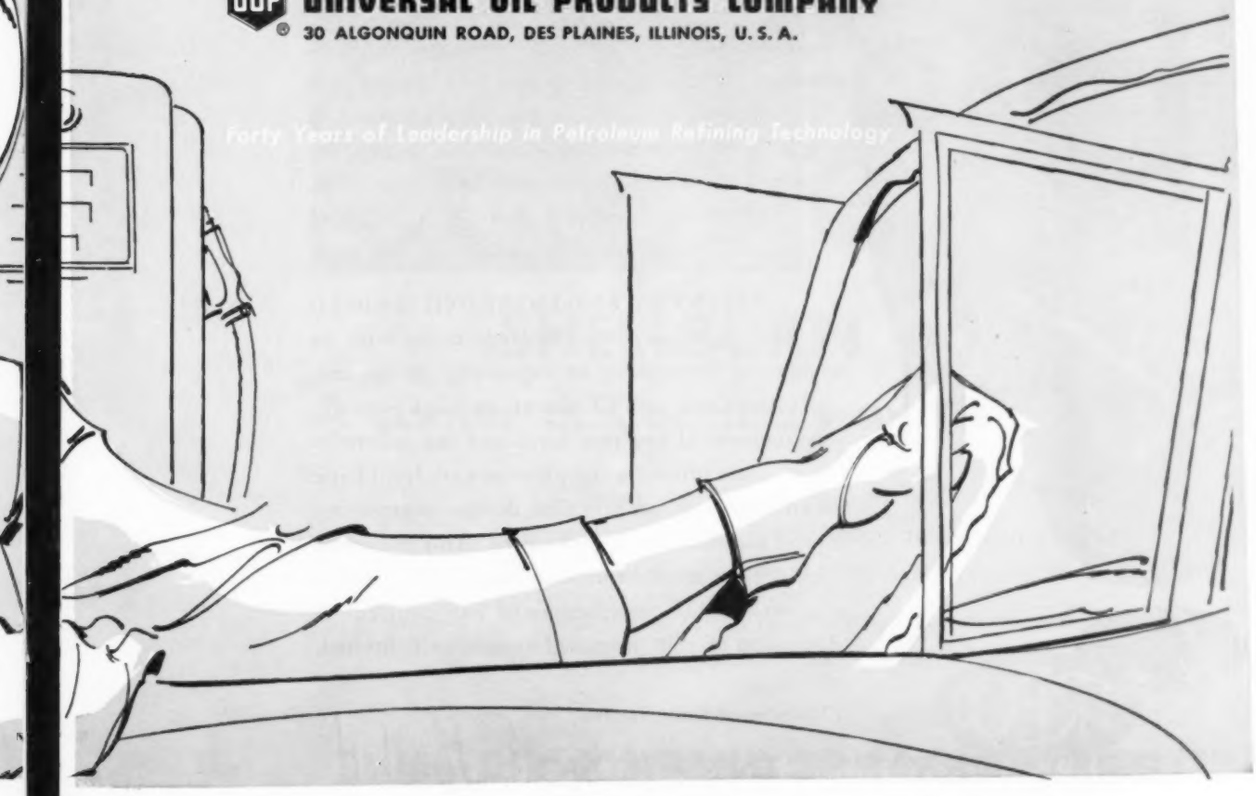

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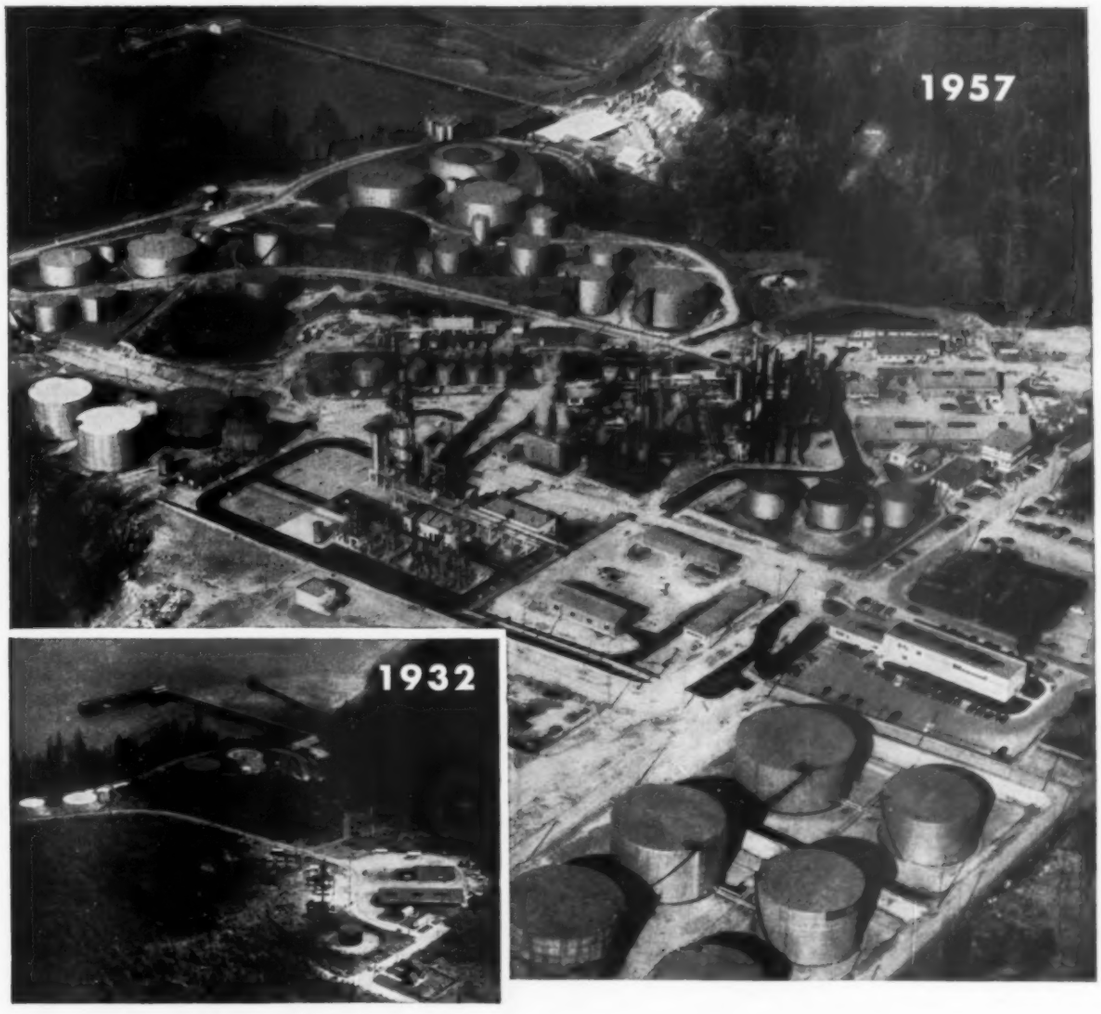

SHELLBURN 1932-1957

A corner of Canada's expansion in 25 years

The great strides Canada has made in the past 25 years are paralleled by the development of the petroleum industry in this country. Shell is proud to be a contributor to this growth.

These aerial views of Shellburn Refinery near Vancouver, taken 25 years apart, depict one aspect of Shell's progress.

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Sign of a better future for you

SHELL

A 6 x 6 Scammell "CONSTRUCTOR" oilfield motive unit with semi-trailer, one of the many operating in Kuwait and other major oilfields of the world.

A triumph of individual craftsmanship

Purpose-built by SCAMMELL for oilfield operation

Mass production doesn't enter into Scammell's scheme of things. Individual design and construction is the hall mark which proves the solid worth of Scammell transport—transport that is purpose-built to fulfil in every detail the requirements of the operator.

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Scammell, from a range of transport varying between 3 tons and 150 tons, can supply all-wheel drive oilfield bed-trucks and motive units; tankers; chassis for well-servicing hoists, drill rigs, cement mixers, etc.

They will be pleased to quote for all types of trucks and trailers built to your specification.

A 4 x 4 Scammel "MOUNTAINEER" 17 ft. wheelbase 1,500 gallons capacity water tanker operating in the Middle East.

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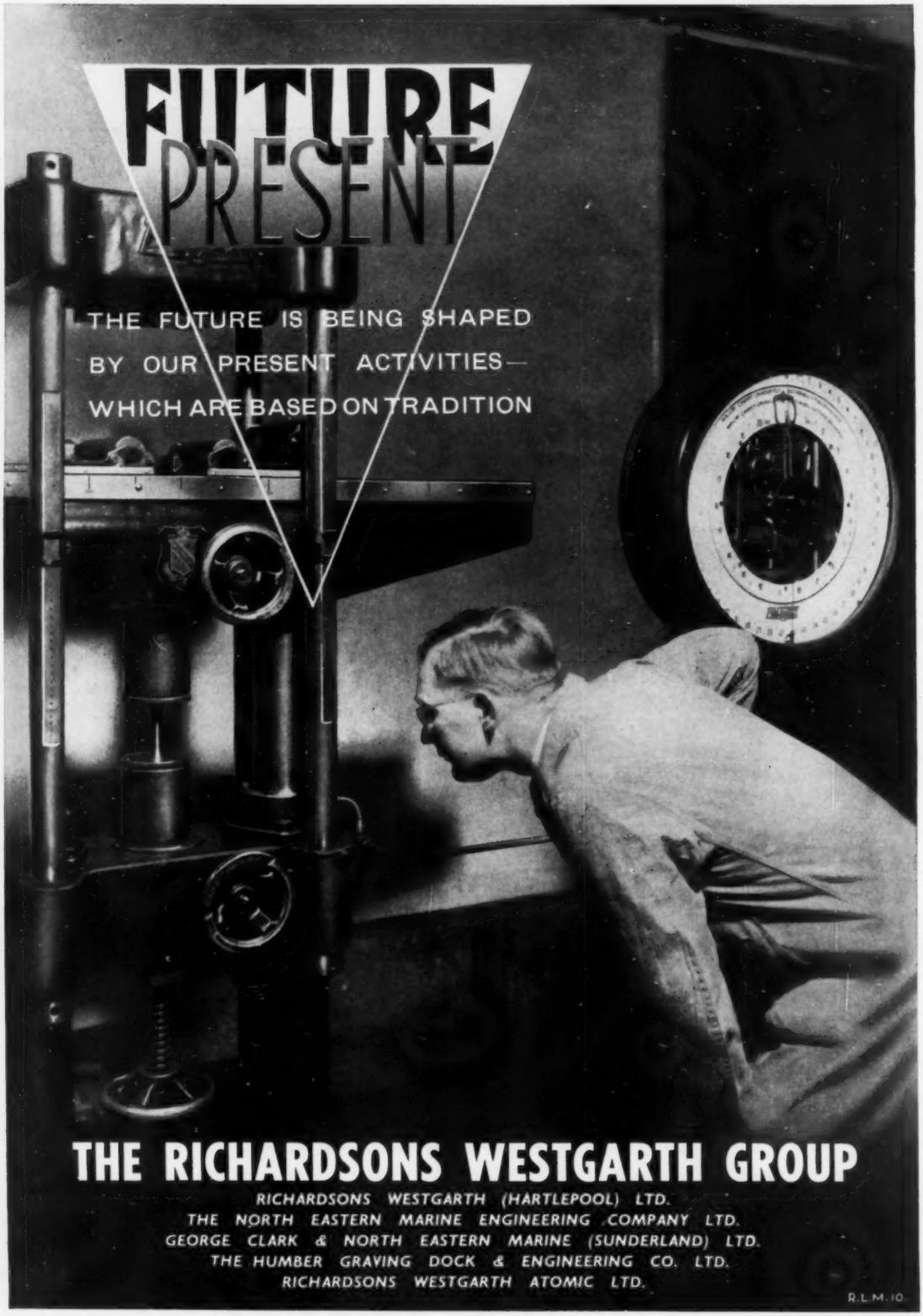
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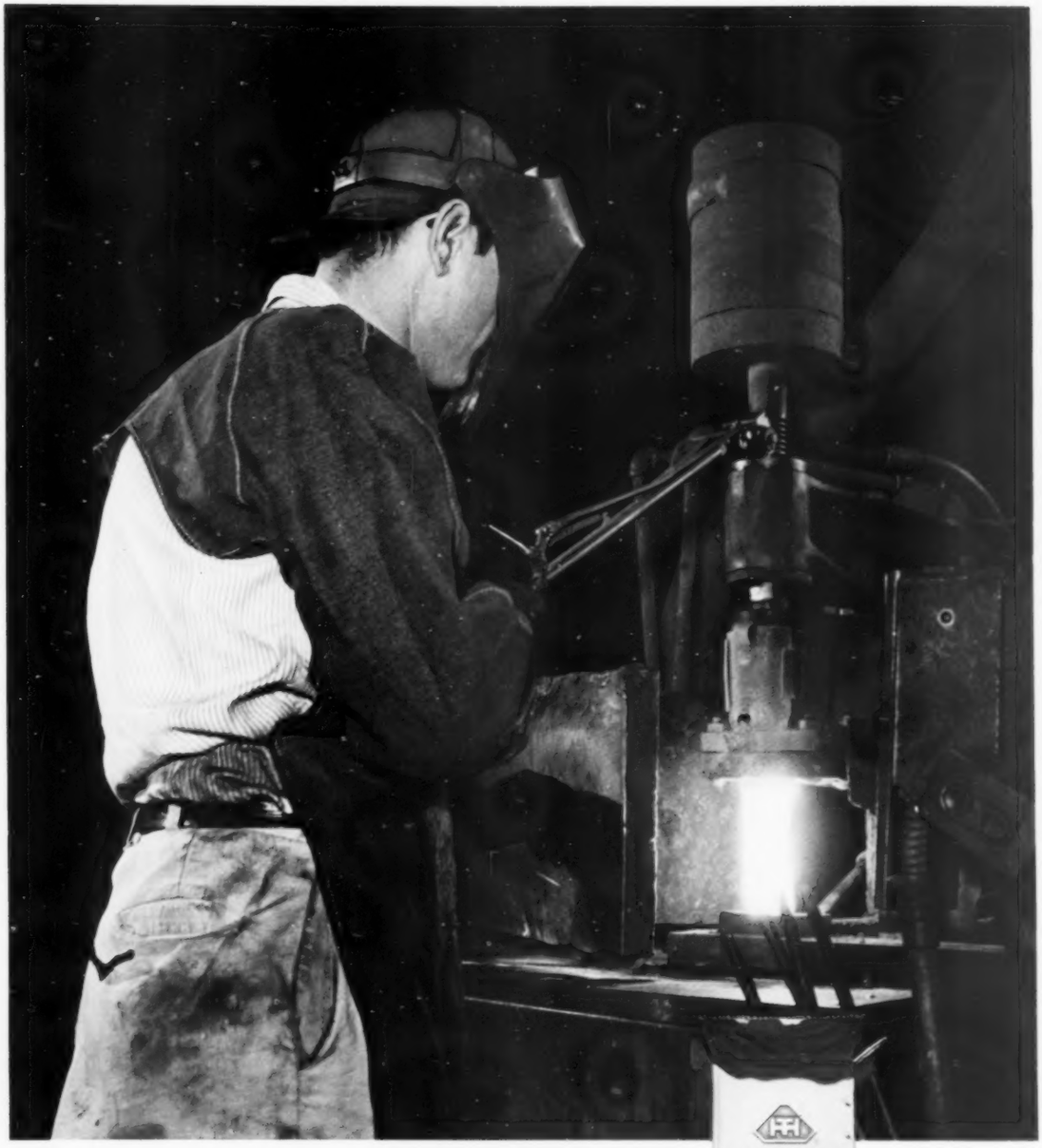
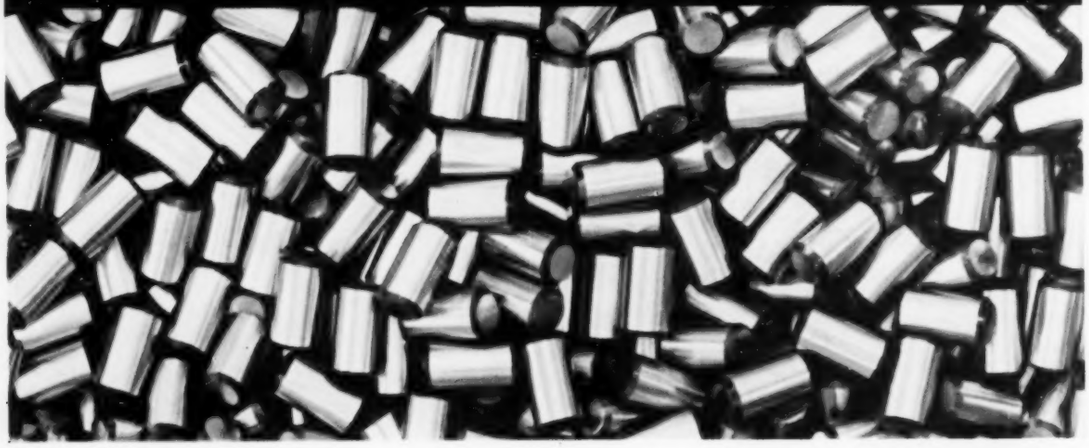


making extra footage for rock bits

The "white hot" metal being alloyed here at over 5000° F., is molten *Hughesite* — one of the hardest known man-made materials. It is 25 times more wear-resistant than hardened steel. *Hughesite* is an exclusive Hughes development. Hughes' methods of applying *Hughesite* to bit teeth and gauge surfaces are increasing the rate of penetration and footage drilled per bit. Here is another example of HUGHES' continuing effort to provide the drilling industry with the best possible tools.

OVER 30 MILLION ROLLER BEARINGS A YEAR... Individually Inspected!



One hundred per cent inspection (not batch sampling) safeguards the quality of the roller bearings that go into Hughes rock bits. Every one of the more than 30 million roller bearings manufactured each year by Hughes goes through four final inspections.

Each bearing is inspected electronically for length, diameter and hardness, and then subjected to ultra-violet light inspection for surface imperfections not detectable by the human eye.

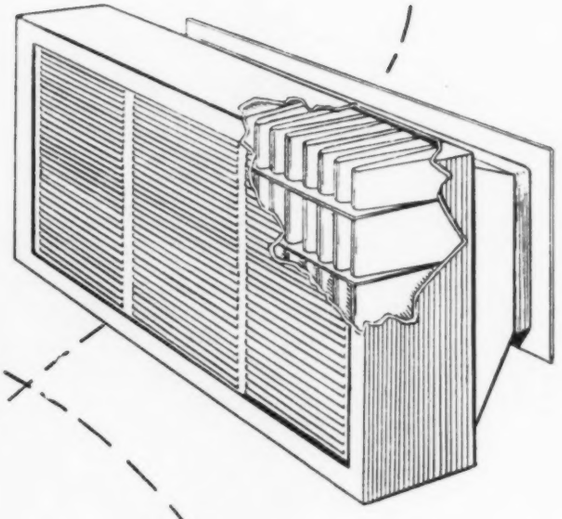
In addition, the special analysis bearing steel—made to Hughes' specifications—must pass a series of metallurgical inspections before it is accepted. This combination of selected raw materials and finished-product inspections assures the consistent, dependable performance of HUGHES rock bits.

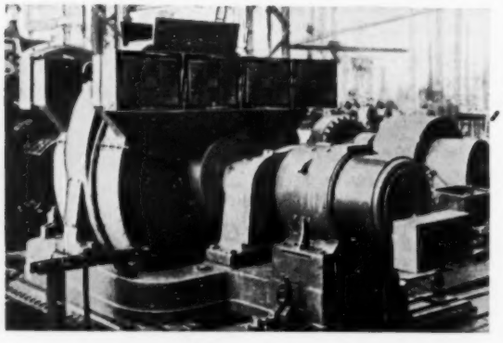
Yes, Virginia, gasoline does cost less than it did 30 years ago. (Before taxes, of course.) Most oilmen know this story; we know how the power in regular gasoline has climbed from 50 octane in the mid '20s to over 90 today. We know, too, what a fantastic value gasoline represents as a commodity. An industrial worker labored 23 minutes to buy a gallon in 1926; today he works just 6½ minutes for a better product. *We* know—but the public does not. What are *you* doing to tell them? **SHELL OIL COMPANY**

VOKES FILTERS

play a vital part in keeping the oil flowing...

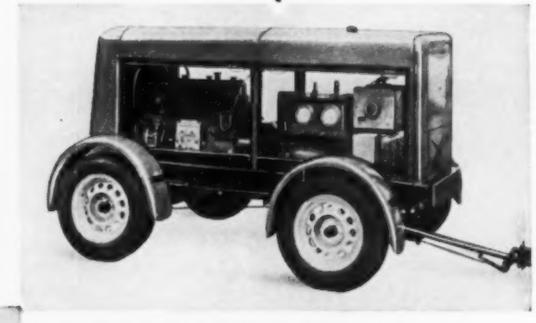
In the blinding desert dust storms which sweep the area of the Iraq pipelines, VOKES filters have twice been chosen for the important task of protecting pumping stations and ancillary equipment . . . proof indeed of the important part which VOKES filtration is playing throughout the world in safeguarding plant and machinery from wear, breakdown and unnecessary depreciation. Below are shown three typical aspects of VOKES protection . . . protection which cannot be jeopardized by the non-availability of element replacements because VOKES FILTERS ARE CLEANABLE.





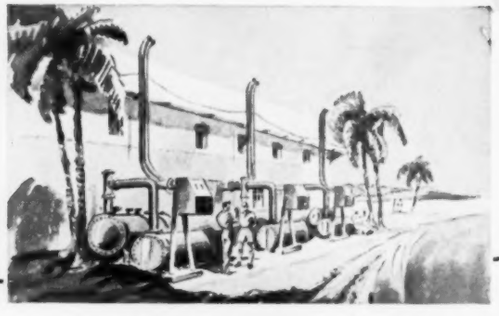
MICRO-VEE PANEL FILTERS FOR ELECTRIC MOTORS

Electric motors breathe too! . . . and these VOKES filters have proved conspicuously successful in preventing the grave damage hitherto sustained during operations in impure air conditions.



VOKES FILTERS FOR ANCILLARY EQUIPMENT

Compressors . . . portable generators . . . welding sets . . . power packs . . . all need protection against the ingress of abrasive dust, whether by air-intake, lubricating oil or fuel.



VOKES FILTERS FOR STATIONARY DIESEL ENGINE

Under abnormal conditions like these, engines have to be doubly protected and these large diesel engines are therefore fitted with Microvee dry fabric filters for cleaning the intake air. Vokes Filters are also specified for atmospheric air filtration in the ventilating systems of many of the desert buildings.

VOKES LIMITED

VOKES LIMITED. *Head Office:* **GUILDFORD, SURREY, ENGLAND**

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V116A

report of Cooper-Bessemer

Centrifugal Operation at Gulf Interstate...

In Gulf Interstate's satellite station near Stanton, Kentucky, this Cooper-Bessemer centrifugal compressor is driven by a 4-cycle Cooper-Bessemer engine operating economically on natural gas from the pipeline.

Automation a Reality

in Gas Pipeline Transmission

Complete control — from 80 miles away — of an unattended main line compressor station...

That's the story of Gulf Interstate's Stanton Station where their Cooper-Bessemer engine-driven centrifugal has now operated over 5500 hours. Here all operating functions such as starting, speed changing, shutting down and valving operations are automatically sequenced and under control of the remote operator.

Advantages of this new kind of set-up are many... big savings in the cost of supervision, building and personnel housing... centralized dispatching for improved system control and with fewer increments of control... quicker adjustment to emergency and new operating conditions.

Cooper-Bessemer centrifugal compressors now meet a wide range of service requirements. Why not talk with the nearest Cooper-Bessemer office about your plans?

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ENGINES: GAS - DIESEL - GAS-DIESEL
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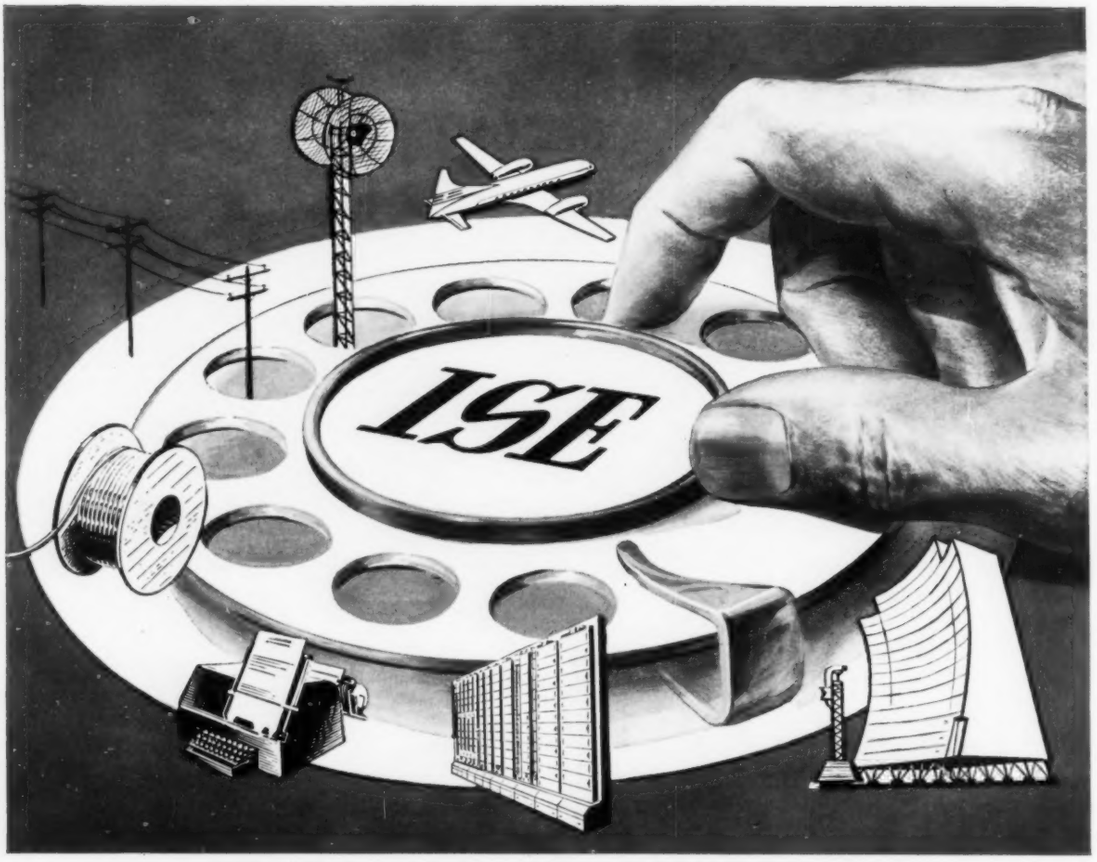

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customer reports prove

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OCECO V-130 Conservation Regulators

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Oceco V-130 Conservation Regulators provide **greater flow capacity,** size for size, and pressure for pressure, **specially at low pressures** than **ever available before.** Our exclusive construction prevents vapors from escaping at less than set operating pressures. Positive flexing action of the membrane, held under tension, peels off and breaks away any icy formations, preventing freeze-ups. These valves bring never before secured **all weather** economy and dependability to the conservation of volatile products stored in cone, round, flat, lifter or expansion roof tanks. **Write for Bulletin No. 522. It gives full details!**

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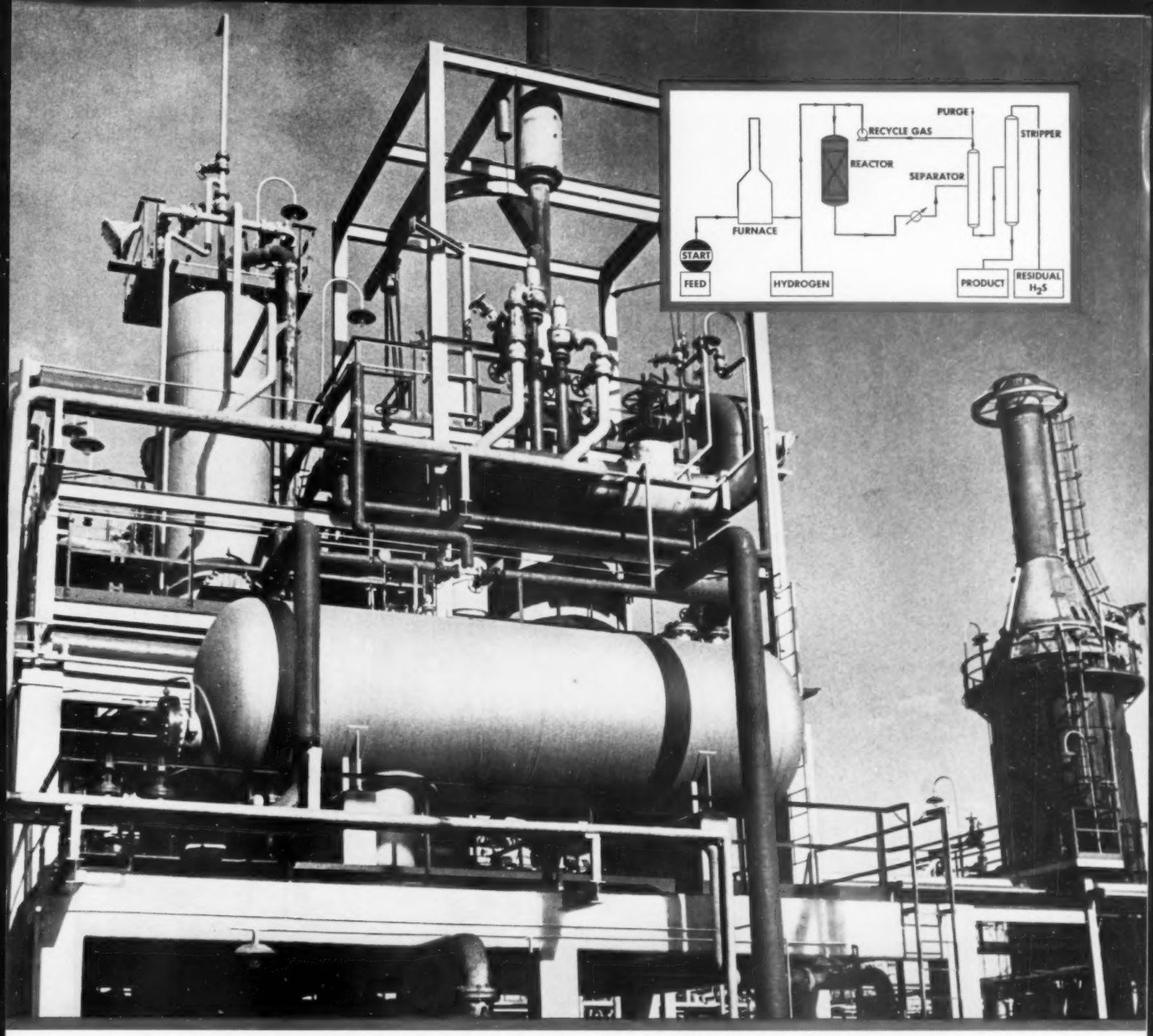

19,500 B/D CRACKED HEATING OIL HYDROFINER, ESSO STANDARD'S BAYWAY REFINERY, LINDEN, N. J.

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Esso Research and Engineering Company offers you *Hydrofining*, a process now being applied to a greater variety of feed stocks than any other hydrogen-treating process. *Hydrofining* uses by-product hydrogen to remove sulfur and other impurities *without yield loss.*

The process improves product stability, odor, color and other quality characteristics without the disadvantages of chemical or clay treating methods. *Hydrofining* is another achievement of the Esso Research program — 38 years of new process developments which have been made available to refiners around the world.

Our *Hydrofining* experience with commercial units processing a wide variety of feed stocks such as naphthas, distillate fuels, lubes and waxes — plus years of hydrogenation research — gives us a unique opportunity to recommend the best design for your plant.

Twenty-three *Hydrofining* installations are on stream; eight more are in the construction or planning stage. Licensees enjoy benefits of continuing *Hydrofining* research. *Hydrofining* can play an important part in helping you process previously unattractive stocks into higher quality products. We would welcome your inquiry.

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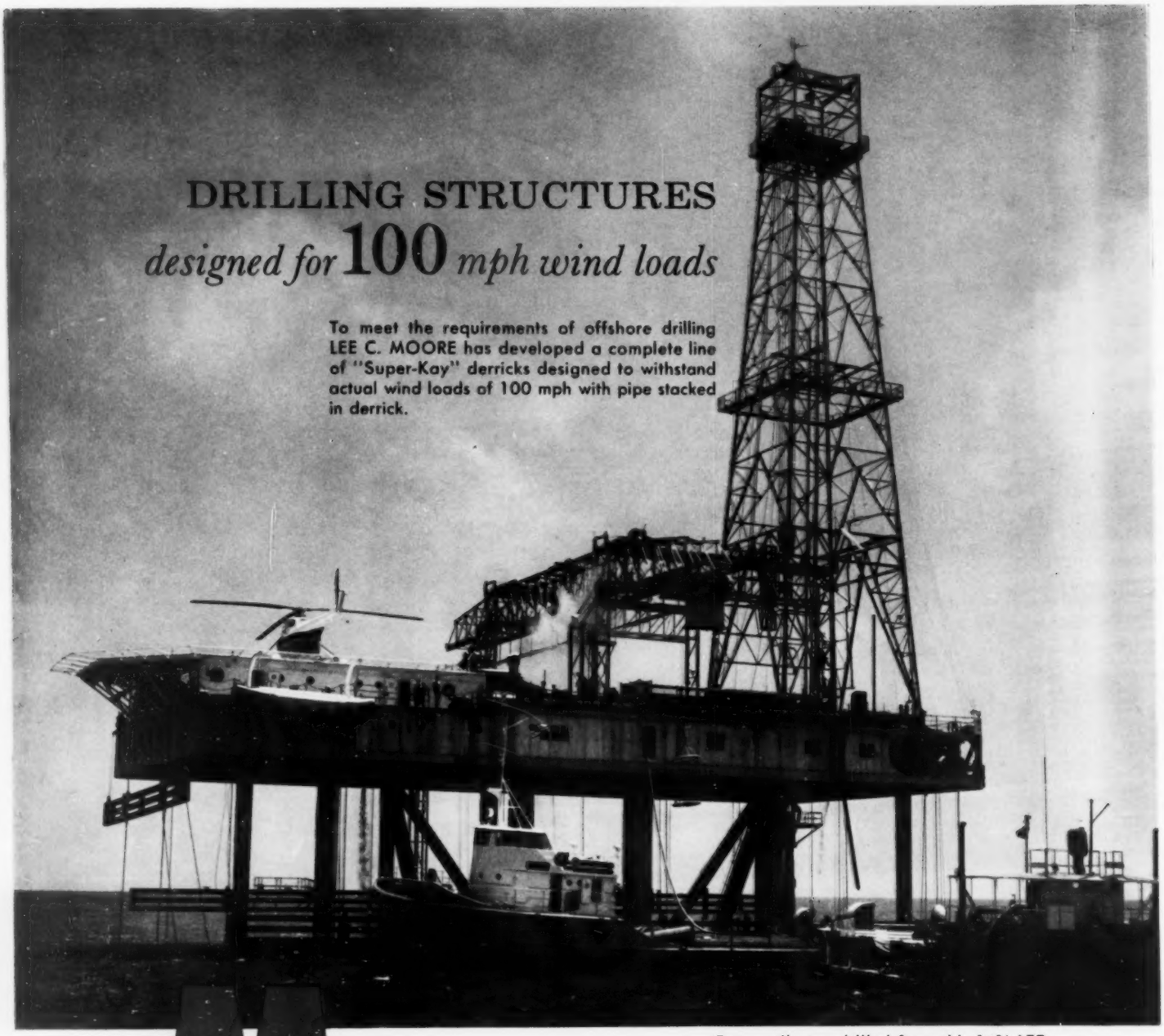
DRILLING STRUCTURES
designed for 100 *mph wind loads*

To meet the requirements of offshore drilling LEE C. MOORE has developed a complete line of "Super-Kay" derricks designed to withstand actual wind loads of 100 mph with pipe stacked in derrick.



Four wells are drilled from this 140′ **LEE C. MOORE SUPER-KAY** derrick by shifting the crown, rotary and racking platform.

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Moore CORPORATION

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W-S Forged Steel Fittings

Now protected with...

new blue rustproof coating

That attractive color you see on our forged carbon steel fittings is a new synthetic coating that effectively protects the fittings against corrosion in stock and in service. The coating completely covers the fittings—inside and outside, thus protecting threads and sockets, as well as external surfaces.

If you are going to paint your piping system for color coding or other reasons, the new coating serves as an excellent base for paint. No objectionable rust or scale to scour off before painting.

All W-S forged carbon steel fittings, in both screw-end and socket-welding types, are now available with the new blue rustproof coating.

Remember the blue color. It labels the fitting a W-S Quality Product.

Send for your copy of
Forged Steel Fittings
Catalog A-3-56

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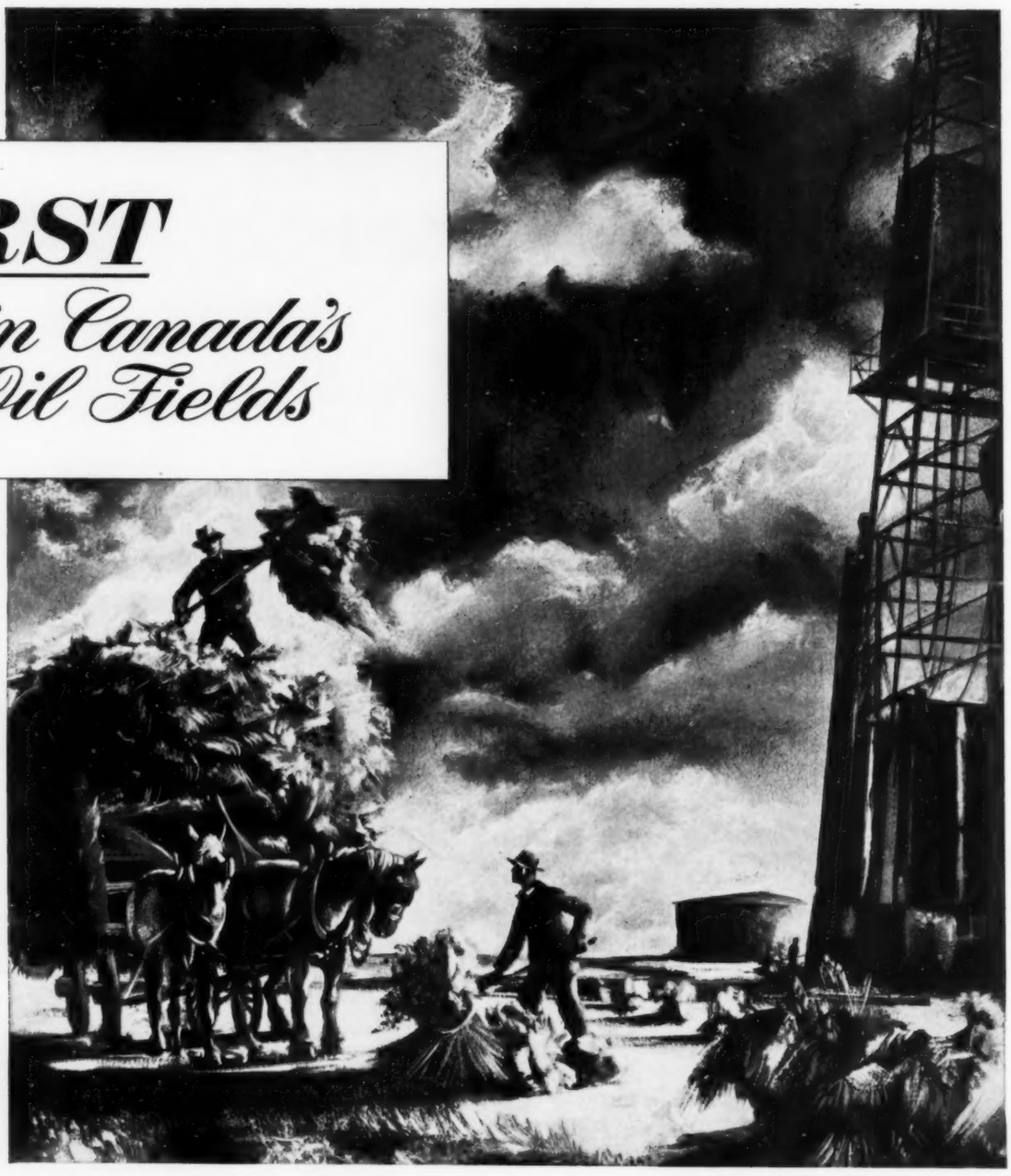
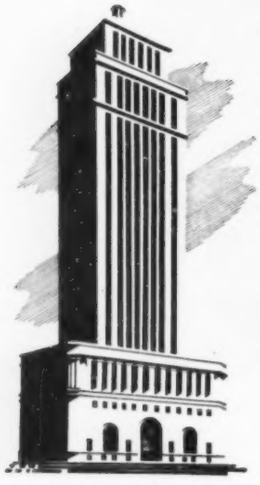


The Royal Bank of Canada, Canada's largest bank, whose clients include many of the most prominent firms in the field, offers exceptional services to the petroleum industry. Its Oil and Gas Department, manned by experienced officers in close touch with the situation, provides information, guidance and practical aid to prospective entrants.

In Alberta, Canada's oil-and-gas-rich province, Royal Bank branches number 65, including Calgary, Edmonton, Leduc, Devon, Redwater, Drayton Valley and Turner Valley. Altogether this bank operates over 300 branches in the oil and gas areas of Western Canada alone.

We do not provide information on oil securities.



The Royal Bank of Canada has just issued a new map showing Canada's oil and gas fields, existing pipelines and projected pipelines. This map is free on request to The Royal Bank of Canada, Oil and Gas Department, 411—8th Avenue West, Calgary, Alberta.

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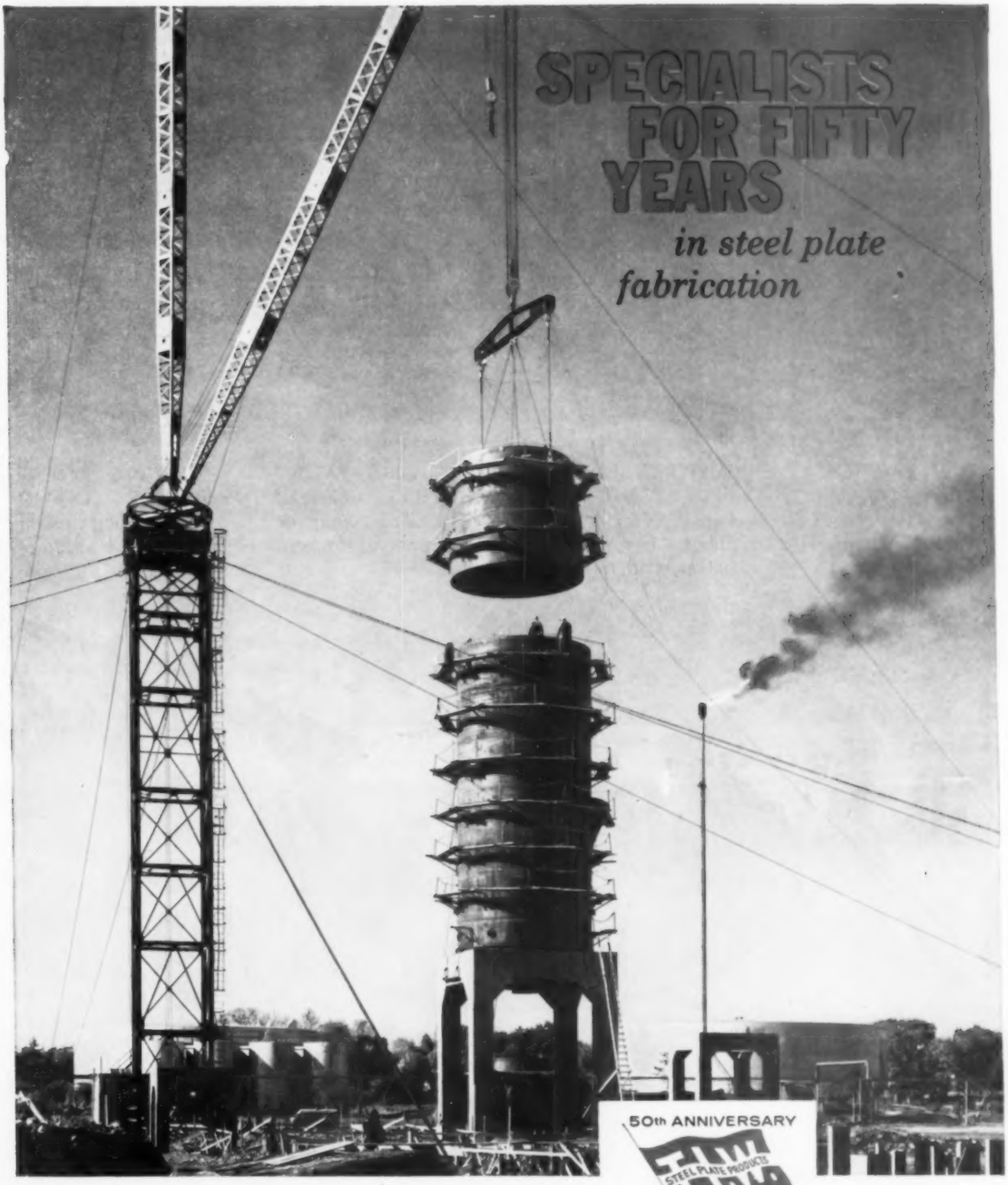
Head Office: Montreal



1907 - 1957 . . . and in all those years just one objective. Some companies have added different lines to their main occupation but we have stuck to the design, fabrication and erection of steel plate and other metals, as they were developed. The result has been leadership in our field so we intend to continue our policy of specialization. Send us your blueprints or problems for designs or quotations.

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For Coupling Bracing Tubes to Strengthen Scaffold.

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For Securing Two Tubes Firmly Together, End to End.

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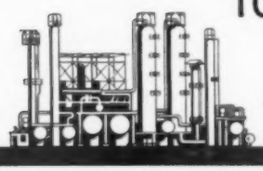

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THE FLOOR AREA OF THIS OFFICE COVERS 107,214,025,881,600 SQUARE FEET

It's quite a large office. It has to be because it covers all of Canada. This is the office of the Natural Resources Development Department of Imperial Bank of Canada. From this office we investigate the potential resource development fields, and gather information and statistics concerning new and established development areas. Mr. R. J. Redrupp, Superintendent of the Natural Resources Development Department, is able to offer financial advice and assistance to businessmen engaged in developing Canada's rich natural resources. He works closely with Mr. A. S. de Rosenroll, Imperial Bank's resident specialist to the oil industry at Calgary, Alberta. This vital new department, first of its kind in a Canadian bank, is another example of Imperial Bank leadership.

IMPERIAL

the **BANK** *that service built*

IMPERIAL BANK OF CANADA

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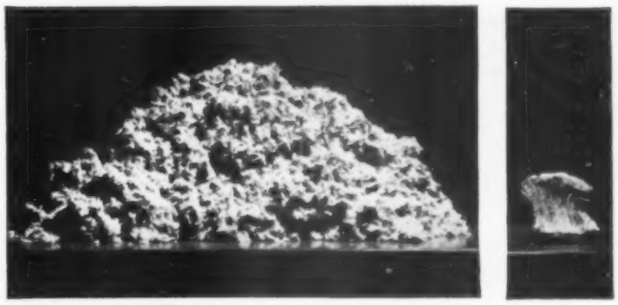
Refinery Insulation

All CAPOSITE moulded insulation materials are made of Amosite asbestos. The photograph clearly demonstrates the immense volume which is obtained when the natural Amosite is fiberised—the sign of high efficiency as an insulating medium.



CAPOSITE is supremely well suited to the thermal insulation of oil refineries. With a limiting temperature of 1000°F., high thermal efficiency and great structural strength and resilience, CAPOSITE has gained for itself a unique position among thermal insulation materials used by the Oil Industry.

CAPOSITE MOULDED ASBESTOS FIBRE PIPE INSULATION

EFFICIENCY DATA SHEET—PIPE SIZES 6" to 10" BORE.

HOT FACE TEMPERATURE °F.			400° F			600° F			800° F		
THERMAL CONDUCTIVITY K B.Th.U. in. sq. ft. hr. in. °F.			0.43			0.47			0.53		
MEAN TEMPERATURE °F.			250			350			450		
Nominal Pipe Size	O.D. pipe	Thickness of Insulation	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.
6"	6¼"	1"	135	87·7	126	233	90·6	167	354	92·5	218
		1½"	102	90·8	107	177	92·9	135	270	94·3	171
		2"	83·6	92·4	97	145	94·1	118	223	95·3	145
		2½"	71·8	93·5	91	125	95·0	107	192	96·0	128
		3"	63·5	94·2	86	110	95·5	100	170	96·4	117
		3½"	57·3	94·8	83	100	96·0	95	154	96·7	109
		4"	52·6	95·2	81	91·7	96·3	91	142	97·0	103
8"	8⅝"	1"	130	88·0	127	225	90·8	169	341	92·7	222
		1½"	97·7	91·0	108	169	93·1	137	258	94·5	174
		2"	79·2	92·7	98	138	94·4	120	211	95·5	148
		2½"	67·4	93·8	92	117	95·2	109	180	96·1	131
		3"	59·2	94·6	87	103	95·8	102	159	96·6	120
		3½"	53·2	95·1	84	92·7	96·2	96	143	96·9	111
		4"	48·5	95·6	82	84·6	96·5	92	131	97·2	105

These figures are compiled from results of official tests by THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON, computed in accordance with formulae shown in BRITISH STANDARD SPECIFICATION appendices.

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ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

385 Madison Avenue — New York 17, N. Y.

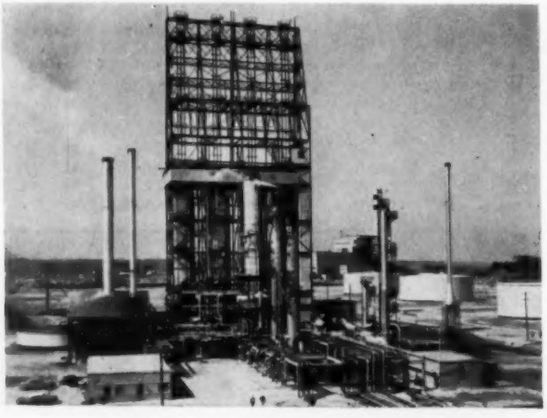
NEW AMOCO DELAYED COKER EXCEEDS EXPECTATIONS...RUNNING MOST DIFFICULT CHARGE STOCK

Lummus designs, engineers and constructs unique 4-coke-drum, 600 ton-per-day unit. Designed for vacuum bottoms containing 25% Conradson Carbon.

A Delayed Coking Unit which handles the heaviest feed ever charged is now in operation at the new Yorktown, Virginia refinery of The American Oil Company.

The unit has been in continuous operation since the initial firing on January 30, 1957, surpassing all guarantees of capacity of charge stock and product specifications, and has been formally accepted before completion of this run.

The fractionating tower produces light and heavy gasoline and light and heavy gas oils meeting all rigid Amoco specifications for the production of high octane unleaded gasoline. Coke produced meets client's specifications for pulverizing for use in boilers.



This delayed coker at Amoco's new Yorktown, Va. refinery handles the heaviest charge on record. Four coke drums measure 17'6" x 75' tangent to tangent. Refinery will help supply unleaded "Amoco-Gas" to an 18-state market.

Evaluation of charge stock in Lummus laboratories and pilot plants supplied the information for special design features that were incorporated into the heater—the heart of the process—and other critical equipment, to handle the heaviest charge stock on record. The unit was designed for a charge mixture of vacuum reduced crude with 25% Conradson Carbon, an API gravity of 6.1°, and an SFS viscosity of 6,000 at 210° F. It was also designed to process a variety of stocks at different recycle ratios to meet required flexibility.

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THIS MONTH'S COVER

Hunting oil on horseback has been found the most convenient in the Canadian Rockies. The cover photograph depicts a Socony Mobil exploration party fording a wide shallow stream with its gear.

Photograph is by K. T. Hyde and color plates are reproduced through the courtesy of Willard A. Colton, managing editor of The Flying Red Horse, house magazine of Socony Mobil Oil Co. Inc.

EAR TO THE AIR

To put modern communications at the service of oilmen everywhere, Halliburton maintains the world's biggest two-way industrial radio network, linking its trucks, autos, pickups, planes and ships to dispatching centers. In emergencies untold thousands of dollars have been saved for well owners by radio-directed Halliburton "rescues". Even more important, keeping an "ear to the air" for coordination of oil well service assignments means maximum convenience for Halliburton customers.

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"PROGRESS IN SERVICE THROUGH RESEARCH"

Canada's petroleum future

CANADA'S young oil industry has been steadily increasing its contribution to the economics of the country. The Suez Canal crisis has now illustrated the potential importance of Canadian oil in the world oil supply picture. This Suez situation, while hopefully a temporary problem, vividly emphasizes the need for a strong petroleum industry in the Western Hemisphere with reserves and production capacity sufficient to meet emergencies.

During 1956, it became more apparent that Western Canada not only has already established a substantial reserve of crude oil, but that it is potentially an area where further large reserves may be found and developed under a politically favorable climate.

Oil is now the number one mineral producing industry in Canada. The nation's daily average production of about 470,000 barrels in 1956 represents an increase of 33% over the previous year. Some 119,000 barrels daily were exported while the remaining 351,000 barrels were used for domestic refinery runs. That was about 55% of the total crude oil processed by Canadian refineries for the year.

Most of Canada's crude oil reserves discovered to date are located in the sparsely populated regions of the Prairie Provinces. Main trunk pipe lines, however, now carry crude oil to the consuming centers in the east and on the west coast. These pipe lines have opened up new markets for Canadian crude oil in the U.S. Pacific Northwest; offshore shipments to California and Japan; and in the Midwest-Lakehead region. Exports of Canadian crude oil in 1956 were nearly double the 1955 amount—and they are expected to average about 200,000 barrels per day during 1957. Only modest increases are indicated in the volume of crude oil moving into the U.S. Midwest-Lakehead region—but in the U.S. Pacific Northwest, the refinery expansion that has been started or announced, together with offshore shipments to California and Japan, should represent the greatest potential source of expansion of markets for Canadian produced crude oil in the immediate future.

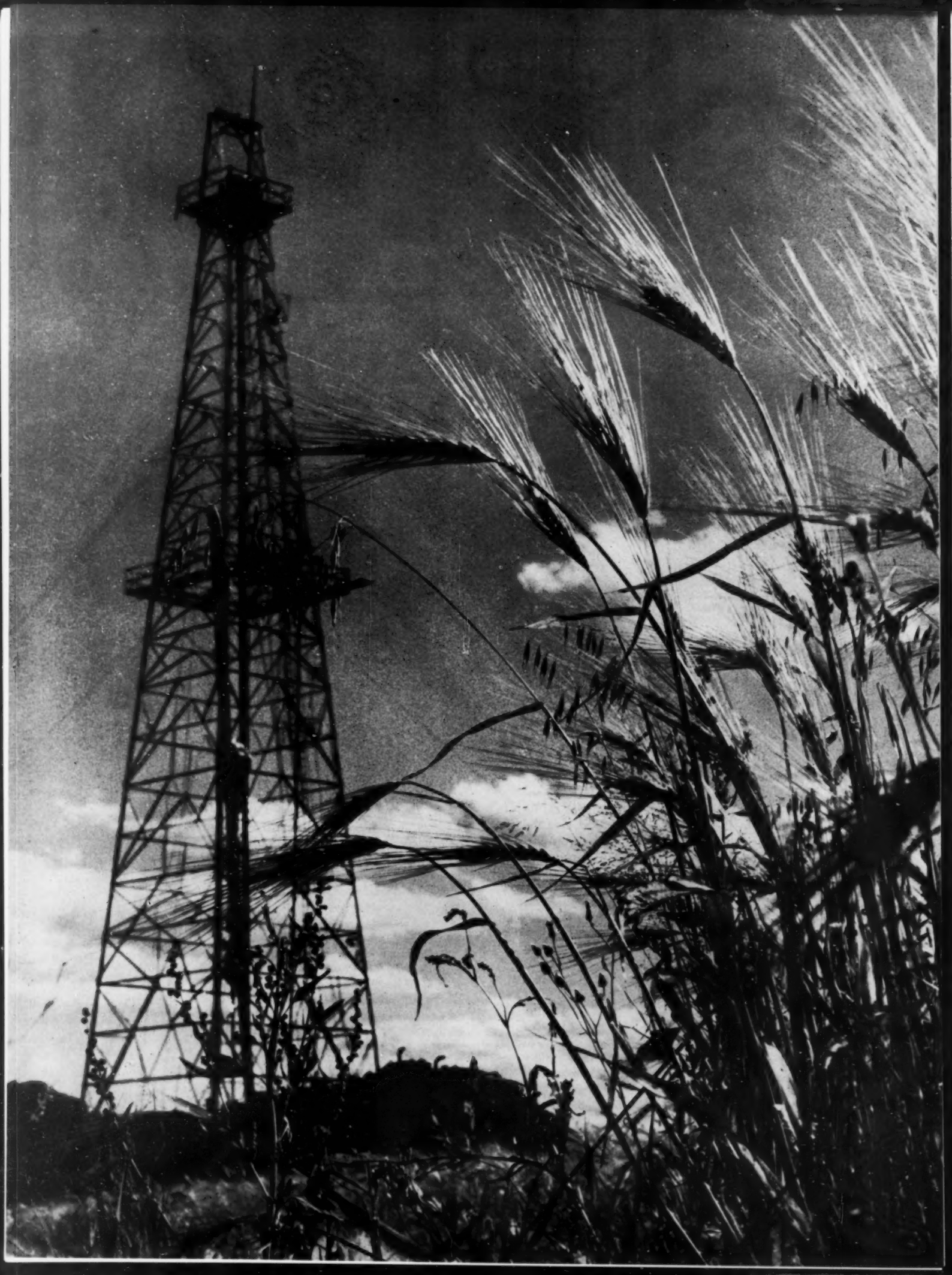
Canada's natural gas industry has heretofore been restricted to local utility distribution in some of the Prairie Province areas. Two large gas transmission lines have now been financed and construction is well along in progress on each of these projects. The Trans-Canada Pipe Line will take Alberta gas east across the Prairies to the large markets of Ontario and Quebec and, in due time, will likely be supplying added volumes into the U.S. Midwest area.

Westcoast Transmission Company Limited will transmit gas from the northwestern section of Alberta and the northeastern part of British Columbia through the interior of British Columbia to the Vancouver region. This Company will also deliver substantial volumes of gas at the International Border to U.S. companies for distribution into the Pacific Northwest. These two initial gas transmission line projects could quite easily be providing an outlet for more than one billion cubic feet of Western Canadian gas a day within the next 5-year period.

Reserves of crude oil and natural gas liquids were increased by 373 million barrels during 1956, to reach a total of 3.129 billion barrels. Western Canada's natural gas reserves at the end of 1956 were estimated at 23.6 trillion cubic feet, representing an increase of more than 2 trillion cubic feet over the 1955 figure.

R. C. Brown

Chairman of the Board of Governors,
Canadian Petroleum Association.
President, Hudson's Bay Oil and Gas Company Limited.



◀ *Photo courtesy Imperial Oil ltd.*

CANADA'S PETROLEUM DECADE

Leduc affords a historic point to look back at Canada's oil achievements during the past 10 years. Oil investment has reached $3½ billion, with prospect of a billion yearly investment over the next two decades.

By William D. Archbold*

William D. Archbold

TEN years have passed since the discovery of the Leduc field, on February 13, 1947, ushered in a new pertoleum era in Canada. The decade which has followed that discovery has been a period of remarkable growth and rapid industrialization throughout the western world. Nowhere has this period of expansion been more striking than in Canada, and petroleum progress has been in the forefront.

In order to illustrate this point, compare the state of Canada's economy, energy supply, and petroleum industry in 1956 with that in 1946, the last full year before the discovery of the Leduc field. In this 10-year period, Canada's total output of goods and services increased by 50%, industrial production increased by two-thirds, and international trade slightly more than doubled. Energy consumption in 1956 was almost 50% more than in 1946, and Canadians had become the second highest per-capita consumers of energy in the world. During this same decade petroleum demand more than tripled—contributing over one-half of the 1956 energy supply, compared to less than one-fourth in 1946. There can be no doubt that some part of Canada's rapid economic growth in this period was directly attributable to the creation of a fully integrated large-scale petroleum industry. Similarly, there can be no doubt that the growth of this industry has been influenced strongly by the dynamic economic climate. However, it is not the purpose of this article to sort out cause and effect, but rather to outline the expansion of the oil industry which has occurred in this period of economic growth.

Western Canada's Crude Oil: Probably the most familiar part of Canada's recent petroleum story is the rapid development of extensive crude-oil production and reserves in western Canada. In 1946, the country's total crude-oil production was only 19,000 b/d, less than one-tenth of its requirements. This production came from a handful of widely separated fields in Ontario, New Brunswick, Saskatchewan, Alberta, and the Northwest Territories. Production in Ontario was less than 1,000 b/d, having little but the historical significance which stems from being the first commercial production in the Western Hemisphere. New Brunswick production was negligible, while the balance of the country's production—in western Canada—was barely sufficient for the local requirements of the agricultural area immediately adjacent to it.

Scattered discoveries over a period of years had kept hope alive for important discoveries in the sedimentary-basin area of the west, however. And finally, in 1947, after years of failures including 133 dry holes, Imperial Oil's producing men discovered the Leduc field, which turned out to be a major oil discovery. In the 10 years which have followed, nearly every major international oil company, and hundreds of smaller companies, have pushed the search across all of the western plains—with significant discoveries occurring in Saskatchewan, Manitoba, and British Columbia, as well as in many additional areas of Alberta. As a result, there are now seven fields, each of which produced more in 1956 than the entire country did in 1946. Several dozen smaller fields also made their contribution to a total production of nearly 470,000 b/d, 25 times the 1946 level.

This sharp increase in production was not achieved without large expenditures of effort and money. In the past 10 years, 5,728 exploratory wells and 11,469 development wells have been drilled. Of these, 10,897 were successful oil wells, 1,207 found gas, and 5,093 were dry. This extensive program of search and development, as well as the accompanying acquisition of mineral acreage, has involved an expenditure of more than $2½ billion in this brief period. These

*Head, Forecast and Statistical Group, Coordination and Economics Dept., Imperial Oil Ltd.

expenditures have been made on a rising scale, as well—reaching nearly $1½ million a day in 1956.

The industry has much to show for its effort over this period. At the end of 1956, remaining crude-oil reserves exceeded 3,100 million barrels, 40 times the pre-Leduc level, despite production during the 10 years of more than 650 million barrels. Proved and probable gas reserves have risen to nearly 23 trillion cubic feet, at the same time, from essentially negligible levels. These reserves have left the producing phase of the industry in a strong position to support the rapidly growing markets for Canadian crude oil and natural gas.

Crude-Oil Markets: The discovery of large reserves of crude oil in landlocked western Canada posed major transportation and marketing problems. The Rocky Mountains on the west, and 2,000 miles on the east, separated these reserves from major markets. When it became apparent that crude-oil production was capable of supplying substantially more than the requirements of the western prairies, a major pipeline to the east was started, and completed 1,130 miles to the Great Lakes late in 1950—making western crude available to Ontario refineries by tanker. Three years later, another major line was completed 718 miles over the mountains to the West Coast. These two pipelines not only opened existing markets to western crude, but also created new markets. New refineries were built in the eastern part of the prairies, in the United States adjacent to the Great Lakes terminus of the Interprovincial Pipe Line, in Ontario, in British Columbia, and in the Puget Sound area of Washington, near the Trans Mountain Pipe Line. As a result, both of these systems have been expanded and extended in the past three years. Interprovincial has been extended to Sarnia, Ontario, an additional 640 miles, and is in the process of being built another 200 miles to Toronto. This line now serves several Michigan refineries, and a branch line supplies two refineries in the Minneapolis area. Trans Mountain has been connected to the two refineries in operation in the Puget Sound area, and has supplied crude to tankers which have moved it to California and to Japan. Through the medium of these two lines, all crude requirements in Canada from Ontario—nearly 3,000 miles to the West Coast—as well as substantial export demand, are now supplied by Canadian crude.

In 1956, Interprovincial delivered 125,000 b/d to Ontario refiners, and a further 46,000 b/d to export markets, in addition to transporting a substantial part of the 165,000 b/d required by prairie refineries. Trans Mountain shipped 60,000 b/d to British Columbia points, and nearly 70,000 b/d into export markets. Refinery expansion and new construction in areas already served by these two pipeline systems insure a continued growth in outlet for Canadian crude oil.

Canadian Demand: Production of nearly half a million barrels a day of crude would not have been possible, however, if it had not been for the truly remarkable growth of domestic markets for petroleum products and the construction of the refineries to supply these markets. Canadian crude and products demand in 1946 was 222,000 b/d; in 1956, it exceeded 720,000 b/d. Since 1953, demand has increased by an amount almost equal to the 1946 total.

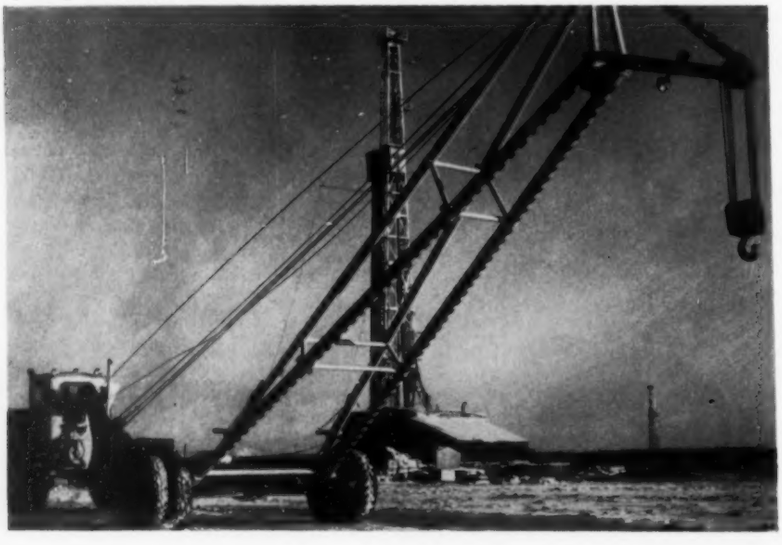
This market expansion has been the product of a number of underlying forces, most prominent of which has been the rapid shift to oil from other fuels for home heating. In 1941, less than 3% of Canada's households were heated by oil. Although no accurate measure exists for 1946, wartime restrictions precluded any significant change in this relationship. In 1956, it is estimated that slightly over half of the country's homes were oil-heated. At the same time, dieselization of the nation's railways, which had hardly started in 1946, is now about half completed, and is being carried out at an increasing tempo. These two factors, combined with the high level of construction activity and resource development which have marked the postwar period, have raised the level of middle-distillate requirements over fivefold to 227,000 b/d in 1956.

The automobile industry has made its contribution to petroleum demand as well. The almost constantly increasing sales of cars and trucks during the past 10 years were capped by 1956 sales of nearly 500,000 vehicles. In addition, the farm-machinery industry has contributed to a very high level of farm mechanization. As a result, gasoline demand has increased to 2½ times its 1946 level, and last year averaged 229,000 b/d. These two major product classifications account for nearly two-thirds of domestic demand, and have provided the bulk of the postwar increase.

The shift to oil fuel has occurred in industry, as well. A more recent feature of heavy fuel-oil demand has been the construction of oil-fired thermal power plants in several areas, where hydroelectric power was not available or fully utilized. In addition, several hundred steam locomotives in western Canada have been converted to oil. The sharp growth in international trade has brought increasing numbers of oil-fired ships to Canada, also. All of these things have brought about a tripling in heavy fuel-oil demand over the past 10 years.

Although these products have accounted for most of the demand increases which have occurred, many other products have contributed as well. Distance has always been a major factor of any Canadian activity. As a result, this country has been in the forefront of aviation for some time. The rapid growth in civil and military aviation has meant sharp increases in aviation-gasoline and turbo-fuel requirements. This process has accelerated since Trans Canada

This "cherry picker" is used to lift heavy equipment along the road leading to the Imperial drill rig at Big Lake, Alberta.



GENERAL STATISTICAL DATA AFFECTING DEMAND

	Motor-Vehicle Registrations		Oil-heated Dwellings
	Cars	Total	
1946	1,239	1,631	—
1947	1,372	1,845	495
1948	1,504	2,047	—
1949	1,672	2,291	—
1950	1,910	2,601	633
1951	2,095	2,868	774
1952	2,296	3,157	944
1953	2,513	3,432	1,260
1954	2,683	3,645	1,417
1955	2,929	3,954	1,656
1956	3,151[e]	4,218	1,843

[e]Estimated.

Crude Production
(Thousands of Barrels Per Day)

	Alberta	Saskatchewan	Manitoba	Eastern Canada	Canada
1946	19	—	—	—	19
1951	126	3	—	1	130
1952	161	5	—	1	167
1953	211	8	2	1	222
1954	241	15	6	1	263
1955	311	31	12	1	355
1956[e]	394	56	17	2	469

[e]Partly estimated.

Airlines introduced commercial turbine-propeller aircraft service to North America in 1954. Highway and airport construction have required rapidly increasing volumes of asphalt, while our major aluminum industry has multiplied its petroleum-coke requirements several times in 10 years. Petrochemical operations have risen from infancy to a major industry consuming over 6,000 b/d in 1956. All of these activities have helped bring about a marked growth in the demand for lubricants, while rural growth has accelerated the demand for liquefied petroleum gases. All of these products together have almost tripled in the 10-year period—contributing markedly to the expansion of domestic demand which, it will be recalled, increased 3¼ times to 720,000 b/d over the 10 years.

Refinery Operations and Product Imports: These rapidly rising requirements have posed marked problems for the manufacturing segment of the industry whose 30 refineries were running 202,000 b/d of crude oil in 1946, and supplying 91% of domestic requirements. During 1956, the industry's 47 refineries had an average throughput of 630,000 b/d and a rated capacity at year-end of over 700,000 b/d. Although greater increases in the demand for fuel oils and specialty products than for gasoline had made the refiners' task more difficult, these operations still supplied 87% of the nation's needs.

The provision of adequate refining capacity could not keep pace with demand growth in the early postwar years, and product imports more than doubled between 1946 and 1951. Since that time, however, the gap has been narrowing, and increases in product imports have been negligible. In fact, there was a decline of 5% in these imports in 1956, despite substantial additions to product inventories.

Tripling refinery capacity has not been the only manufacturing problem during the period, however. In common with its counterparts in other countries, the Canadian industry has spent many millions of dollars on equipment to improve quality and yield, as a result of higher automobile requirements and the greater proportionate requirement of middle distillates and specialty products.

Investment: It is apparent that expansion of this magnitude has required large capital investments. The exploration for, and development of, petroleum reserves and the acquisition of mineral leases have entailed an investment of over $2½ billion. The pipelines and other transportation facilities, the refineries, and the distribution and marketing facilities required for this task have entailed the investment of an additional billion dollars. The speed and magnitude of this investment have meant, of necessity, that the source of a substantial portion of the funds has been outside Canada, largely the United States.

Not an oil field on the moon—only oil and gas seepapegs after the blowout of Atlantic No. 3 in the Leduc field.

It has been forecast that the future expansion of the industry may require an average of nearly a billion dollars a year over the next 20 or 25 years. It can be expected, therefore, that external sources of funds will continue to play an important role. However, in common with developing resource industries the world over, it is reasonable to expect that these funds will be generated increasingly from internal sources.

There is every confidence that this large investment will enable the Canadian industry to meet the constantly increasing requirements of the future. Although it is probably too much to expect demand to triple again in the next 10 years and crude production is unlikely to grow another 25 times, there is every indication that future growth in all phases of Canada's petroleum industry will be substantial, and that Canada will continue in the forefront of the oil countries of the world. END

Crude and Product Demand
(Thousands of Barrels Per Day)

	British Columbia	Prairies	Ontario-Quebec	Atlantic Provinces	Canada
1946	30	44	130	18	222
1951	48	91	243	38	420
1952	55	101	268	43	467
1953	58	112	298	45	513
1954	61	120	328	50	559
1955	71	142	375	57	645
1956e	79	154	423	65	721

ePartly estimated.

Refinery Capacities
(Thousands of Barrels Per Day)

	British Columbia	Prairies	Eastern Canada	Canada
1946	22	40	183	245
1951	29	121	261	411
1952	30	130	288	448
1953	46	145	318	509
1954	54	161	350	565
1955	64	176	406	646
1956e	71	184	448	703

ePartly estimated.

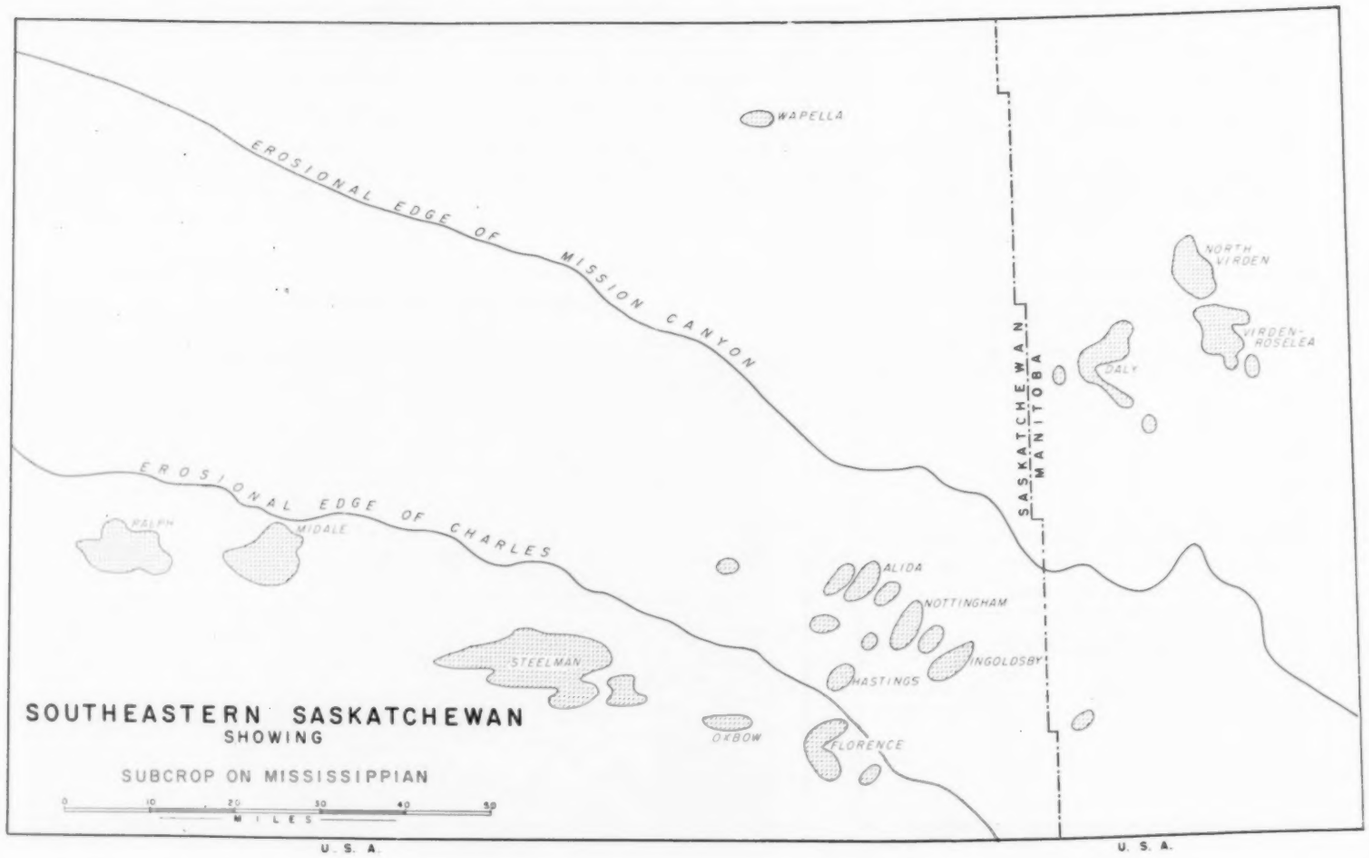
CANADIAN SUPPLY AND DEMAND FOR OIL
(Data in Thousands of Barrels Per Day)

	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
DEMAND											
Domestic Demand											
Motor gasoline	91	102	112	125	137	151	171	186	194	214	229
Middle distillates	40	61	63	69	87	101	120	133	162	199	227
Heavy fuel	58	67	73	80	93	108	112	122	126	136	158
Other products	33	37	40	45	50	60	64	72	77	96	107
TOTAL	222	267	288	319	367	420	467	513	559	645	721
Exports											
Crude	—	—	—	—	—	1	3	7	7	46	116
Products	3	3	5	1	1	1	3	1	2	2	6
TOTAL DEMAND	225	270	293	320	368	422	473	521	568	693	843
SUPPLY											
Crude production	19	20	33	57	78	130	167	222	263	355	469
Natural-gas liquids, etc.	1	1	1	1	2	2	3	3	4	11	13
Imports—Crude	173	191	212	207	224	228	225	223	210	238	293
—Products	36	64	65	55	75	85	93	98	99	103	98
TOTAL SUPPLY	229	276	311	320	379	445	488	546	576	707	873
Inventory Change	+4	+6	+18	—	+11	+23	+15	+25	+8	+14	+30
Crude Runs	202	221	240	262	299	351	380	425	464	529	630

Shot-hole drilling in the Canadian bush: note the tracked vehicles for use on rough, soft ground. (Photo courtesy of Royalite Oil Co. Ltd.)

NEW DISCOVERIES

The western Canada sedimentary basin enjoyed a record petroleum exploratory year with a discovery rate of one to five. Reserves were up 373 million barrels at the year's end of which one-third was developed in southeast Saskatchewan. Drilling was up about 20% in 1956 and will probably remain at that level during 1957.



ADD TO CANADIAN RESERVES

by Gallup and Buckland

W. B. GALLUP was employed by Anglo Canadian Oil Co. Ltd., the Home Oil Co. Ltd. and the Petroleum and Natural Gas Conservation Board of Alberta before joining the Royalite Oil Co. Ltd. in 1942 as resident geologist in the Turner Valley oil field. He was chief geologist for Royalite prior to the establishment of Gallup, Buckland and Farney Ltd.

R. S. BUCKLAND graduated in 1949 in geological engineering from the University of Saskatchewan. He joined the exploration department of Royalite Oil Co. Ltd. the same year. Prior to beginning consulting practice he was with the petroleum engineering department of Royalite, employed in land evaluation and reservoir studies.

THE petroleum industry in western Canada in 1956 enjoyed a most successful and record exploratory development year. Total drilling was up 15%, a circumstance largely due to the great activity in southeastern Saskatchewan where development and exploration of the Mississippian of the northeast flank of the Williston Basin resulted in an increase of 48% in reserves, or 122 million barrels over 1955.

Tables 1 and 2 are for Alberta only. They do, however, illustrate the growth of the industry and the development of energy being expended in exploration. Note that the relatively low increase of 14% in 1954 production coincides with the fall-off in drilling in 1953-54. A very large increase in production in 1951 (when there was much less drilling than there is now) is the result of the development of the reef fields of the Edmonton area. It is probable that the increase in the drilling in 1956 and anticipated equivalent amount in 1957 will show up in the reserve and production figures in the ensuing three years.

Out of 927 wildcat and major stepout wells in western Canada during 1956, 190 were successful—an oil discovery ratio of one to five. Fig. 1 is a map of the western Canada sedimentary basin, showing the position of significant discoveries which are discussed below. One of the striking features of the year's activity was the localization of most exploratory drilling on the western and southeastern edge of the basin. Concentration to the west was due to, first, a record amount of drilling in the foothills as a result of incentive derived from Husky-Phillips successes at Savannah Creek and the advanced status of so many petroleum and natural-gas reservations, together with the culmination of preliminary exploration on these lands. Second, the Alberta syncline, which lies adjacent to and parallels the length of the foothills, enjoyed a considerable amount of activity through the development of the Pembina Cardium oil field, and the Sundre and Westward Ho Mississippian fields together with some exploration for other petroleum occurrences of this type. On the other side of the western Canada sedimentary basin, the concentrated development of previously discovered and new oil pools, together with a great deal of wildcatting—all at depths usually not exceeding 4,700 ft—accounts for the great increase in Saskatchewan.

TABLE 1

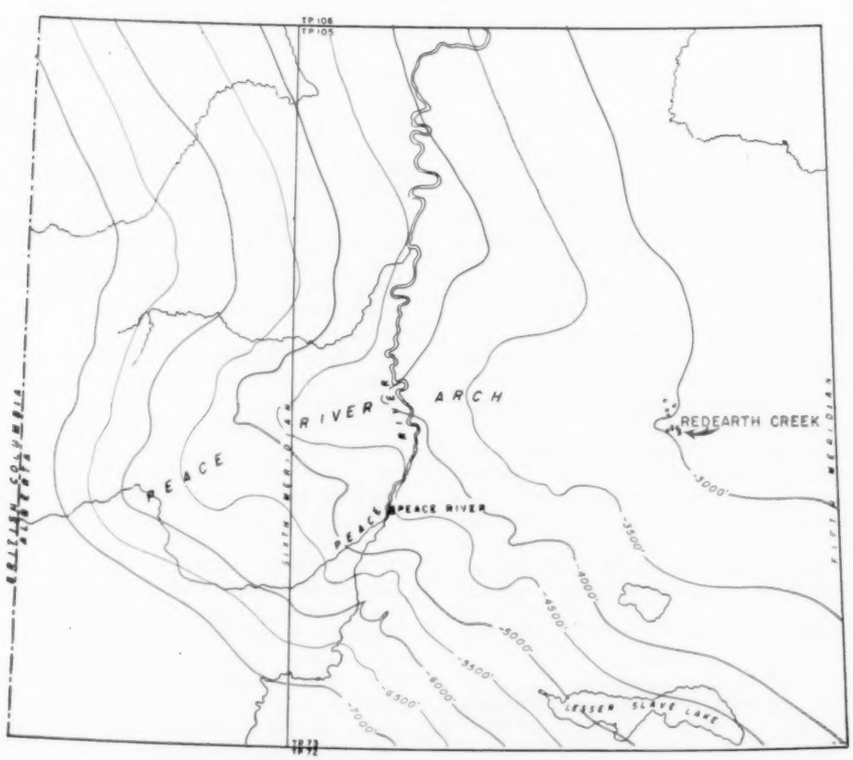
Year	CRUDE-OIL PRODUCTION —STOCK-TANK BARRELS— (nearest 1,000)	Percentage Increase
1950	28,378,000	
1951	46,377,000	75
1952	60,617,000	28
1953	76,816,000	27
1954	87,714,000	14
1955	113,035,000	29
1956	143,910,000	27

Tar Sands: Although of a rather special nature, one of the most important events in the exploration picture for the year was the renewed activity in the Athabaska oil sands. For the past two years, exploration and research concerning the development of this deposit, estimated at from 100 to 300 billion barrels in place, has been increasing steadily. During 1955-56, Royalite Oil Co., of Calgary, conducted an intensive field study of the Coulson method of extraction, a centrifical technique of extracting the bitumen from the sand. These experiments were carried on at Bitumount, following which Royalite explored and developed by a coring program a reported one billion barrels reserves in the Mildred-Ruth Lake area. Open-pit mining methods have been adapted to the problem as well. Early in the year 1957, Royalite announced that it had resolved both problems sufficiently well so that it might expect a pipeline product by 1960.

CANADIAN PETROLEUM ASSOCIATION'S COMPILATION OF 1956
ESTIMATED PROVED RESERVES OF LIQUID HYDROCARBONS IN CANADA
(In 35 Imperial gallon barrels, equivalent to 42 USA gallon barrels)
(thousands of barrels)

	Proved Reserves as of Dec. 31, 1955	Changes in Proved Reserves due to Extensions (New Oil) and revisions during 1956	Proved Reserves discovered in New Fields and in New Pools in Old Fields in 1956*	Production during 1956	Proved Reserves as of Dec. 31, 1956, Columns 1, 2 & 3 less Column 4	Changes in Reserves during 1956, Column 5 less Column 1
	(1)	(2)	(3)	(4)	(5)	(6)
CRUDE OIL						
Northwest Territories	53,707	—	—	449	53,258	—449
Alberta & British Columbia	2,169,985	344,213	19,721	142,141	2,391,778	221,793
Saskatchewan	236,872	113,711	28,394	20,284	358,693	121,821
Manitoba	45,211	2,577	56	5,839	42,005	—3,206
Ontario and New Brunswick	3,759	465	20	608	3,636	—123
TOTAL CRUDE OIL	2,509,534	460,966	48,191	169,321	2,849,370	339,836
#NATURAL GAS LIQUIDS	247,085	20,505	15,000	2,656	279,934	32,849
TOTAL LIQUID HYDROCARBONS IN CANADA	2,756,619	281,471	63,191	171,977	3,129,304	372,685

* Only a limited area is assigned to each new discovery even though the committee may believe that eventually a much larger area will produce, because in this report the committee is concerned only with actually proved reserves. Hence figures in this column may be considered minimum figures.
# All natural gas liquids located in Alberta and British Columbia.



PEACE RIVER AREA
SHOWING
CONTOURS ON PRECAMBRIAN
INTERVAL - 500 FEET

0 50 100
— MILES —

About one-half million acres were then held by various companies, largely on the west side of the Athabaska River, at the close of the year. Following Royalite's announcement early in January of 1957, more Athabaska oil-sands permits were taken out, so that the total acreage now held is on the order of one million acres. These permits all carry assessement commitments, so that a great deal of activity is anticipated in the area for 1957 and early 1958—a circumstance which no doubt will result in a resolution of the tar-sands problem at an earlier date than might have been anticipated two years ago.

Table 3 shows the estimated proved oil reserves for all of Canada as of the end of 1956.

The February 1957 market for Canada was at 570,000 b/d, or at the rate of approximately 208 million barrels annually. The increase in proved reserves in 1956 over 1955 was approximately 373 million barrels. Some authorities forecast a daily million-barrel market for Canada by 1960. This means that it will be necessary to triple our present annual discovery rate by that time in order to maintain our current reserve position. Discoveries in any given year usually do not achieve their full significance in the reserve picture until well on in the following year or, in many instances, the end of the second year following the discovery. The 373-million-barrel increase in the 1956 reserve over 1955 may be one-third accounted for by the 122-million-barrel increase in Saskatchewan. A large portion of the Alberta increase is due to the development of the Pembina field, which was discovered in 1953, where serious development began in 1954—so that current minimum reserve estimates indicate 15 billion barrels underlying 360,000 acres being developed with 80-acre spacing.

The 48% improvement in the Saskatchewan reserves for 1956 was achieved largely during that year when a large portion of the 41 drilling rigs operating in that province were engaged in exploration and development drilling in the southeast portion of the province. Of the 190 indicated oil discoveries in western Canada compared with 641 dry holes obtained, only a few have any real apparent significance. Many of these reported discoveries are, in fact, major stepouts. It is probable, then, that the following few discoveries will be found in time to have the real effect on the 1957 and 1958 reserve pictures—this, of course, excepting any 1956 discoveries which may be developed with unusual rapidity.

Red Earth: The recent discovery of oil in the Granite Wash of early Paleozoic age at 4,750 ft, by the Union Oil Co., in northern Alberta precipitated one of the most spectacular land plays western Canada has experienced for some time. The accumulation is in an early Paleozoic Granite Wash immediately overlying the Precambrain. The source of the hydrocarbons is most probably the overlying Middle Devonian,

but the oil may have migrated some distance. The development of the wash is apparently controlled by the Precambrain topography. Contours on the Precambrian are shown in Fig. 2. Three wells have been completed; the discovery well had an initial production of 900 b/d from a 40-ft pay section. At this time there existed in northern Alberta a great deal of Crown land available for filing as petroleum and natural-gas reservations. Within hours after the announcement of the discovery, hundreds of thousands of acres were filed on in Edmonton.

The region of the discovery is unsettled, unsurveyed, and covered with muskeg and light forest, as is most of the country believed to encompass the aerial extent of the Granite Wash. Therefore, operators are confined largely to winter operations due to the prevalence of muskegs, lakes, and streams. For that reason, although the Red Earth discovery is encouraging and the reserves of that field alone may be attractive, there has not been much opportunity to follow it up. In fact, only about a four-month period of favorable working conditions has obtained over the general area since the discovery. Under these conditions, the real significance of the Red Earth discovery may take some time to develop. It is probable that the final result will be a number of small fields of a similar nature over northern Alberta. The payout should be rapid when market is established, but it is possible that the final effect on the overall reserve picture may not be great and, certainly, will not be soon.

Boundary Lake: Of importance was the discovery of Triassic oil in the southeastern extension of the Boundary Lake gas field at Texaco North Foothills Boundary Lake A-14-6 well late in 1955, with some follow-up drilling in 1956. The initial potential was reported at 10 bbl per hour for a 5-hour test, through a 24/64-in. choke, of 34-gravity oil from the interval 4,281 ft to 4,319 ft. This is the only important Triassic discovery in western Canada to date. Development of a market for this oil will, of course, be delayed pending an outlet which will probably be by a pipeline to the Pacific coast.

Virginia Hills: This well, located 125 miles northwest of Edmonton and drilled by a Home Oil Co.-Union Oil team, found oil in the Slave Point formation of Middle Devonian age at a depth of 9,250 ft. A drill-stem test yielded 3,000 mcf of gas, with a recovery of 5,000 ft of 40 API oil during a 70-min test. This is of greatest significance to the Alberta forecast, as it marks the discovery of Middle Devonian oil in western Canada in a hitherto unexplored area, and should result in a considerable amount of drilling and consequent further discoveries of oil in the Slave Point formation of northwestern Alberta. The Slave Point formation consists of a dolomite sequence about 100 ft thick. It is commonly porous, but prior to the Virginia Hills discovery yielded only rather substantial flows of salt water.

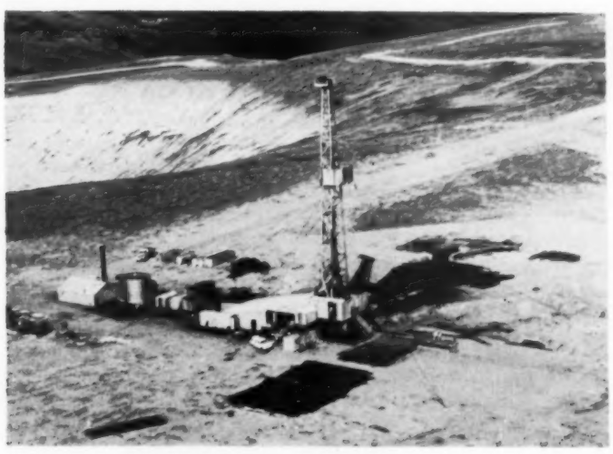
Cutbank: The Pembina field reserves have been given above. Further, it was stated that the true significance of the Pembina discovery was not revealed until nearly two years after that event. In consideration of this, it may be that the discovery of Cardium oil by the Baysel-Regent-French Petroleum team at 5,220 ft in their well in Township 64, Range 6, W6, 60 miles south of Grande Prairie, may be very important. The initial production was on the order of 65 b/d from a pay thickness of about 20 ft. The well is now shut in due to mechanical difficulties. It is about 175 miles northwest along strike from the Pembina field. In this general area there overlies the Cardium, a similar sand development known as the Badheart. Since this discovery is further removed from the Pembina field than any other post-Pembina Cardium discoveries and in an area where there have been one or two other shows in this formation, it may be most important—particularly in view of the fact that both the Cardium and Badheart are developed hereabouts.

Texaco High River: The Texaco Oil Co. made a crude-oil discovery in a dolomite facies near the top of the Upper Devonian, 30 miles south of Calgary, at 9,600 ft. Initial potential was 320 bbl of 39-gravity oil per day. Although sulfurous gas previously had been discovered from this approximate horizon 15 miles to the north, this is the first occurrence of oil in this formation.

Williston Basin: The southeastern Saskatchewan portion of the Williston Basin, which is actually the northeastern rim of that feature, was the scene of the most active exploration and development play in the western Canada sedimentary basin. Approximately 50 major stepouts and wildcat discoveries accounted for most of the 48% increase in reserves, as all but four of these discoveries were in the Williston Basin. Oil in this area occurs in the Charles and underlying Mission Canyon formations of Mississippian age. Accumulation is in stratigraphic and erosional traps, with possibly some structural control. Pay thicknesses are on the order of 30 ft to 60 ft at depths ranging from 3,500 ft to 5,000 ft.

The fields are numerous, small in aerial extent, and occur along definitely established trends—striking about 60 deg west of north. The control is the subcrop of the Mississippian, together with facies changes in immediately underlying strata. It is, therefore, probable that the high incidence of discovery will continue for some time as detailed knowledge is built up. Therefore, it is possible that the development of reserves in southeastern Saskatchewan during 1957 may be similar to that in 1956. Further, in this respect, discoveries may be made in deeper horizons.

Visible plans and commitments for the year 1957 indicate a degree of drilling activity similar to that of the past year, with a possible slight fall-off in development and increase in exploratory drilling. By this token, it would then seem that the overall development of reserves might be slightly lower, but that a slightly larger number of wildcat discoveries might be expected. END



Drilling on Plateau Mountain of the Savannah Creek structure. The level plain in the foreground is above timberline at an altitude of 8,100 ft. (Photo courtesy of Husky Oil and Refining Co.)

TABLE 2

ALBERTA DRILLING ACTIVITIES

Year	Development Drilling (feet)	EXPLORATORY DRILLING (Outpost, Deep Pool, Wildcat) (feet)	Total Footage	Total No. of Wells	Average (per well in feet)
1951	3,294,389	1,823,972	5,118,361	1,197	4,275
1952	4,662,191	2,351,361	7,013,552	1,619	4,340
1953	4,263,454	2,090,251	6,353,705	1,426	4,455
1954	3,207,841	2,466,918	5,674,759	1,153	4,940
1955	6,201,839	2,242,739	8,444,578	1,627	5,200
1956	7,695,927	2,399,652	10,095,579	1,899	5,780

Ditching operations preparatory to laying pipe for water injection.

Ditch from "B" plant No. 1—with multiple lines placed in the ditch.

Aerial view of "F" plant for water injection at Pembina.

Pembina Pressure Maintenance

THE immense Pembina oil field in central Alberta is "flexing its muscles" to create another milestone in North American oil-field history. When the discovery well was completed in the Cardium reservoir, in June 1953, a drilling program was triggered which resulted in the definition of an oil reservoir having the largest areal extent on the North American continent.

With the official sanction of the Petroleum and Natural Gas Conservation Board of Alberta, the mechanics were set in motion by which the largest pressure-maintenance project in the world may evolve. During 1956, Canadian Seaboard, Stanolind, and Mobil companies separately undertook water-injection operations in the Cardium reservoir in the Pembina field. Although both the Stanolind and Mobil projects are in the pilot-operation category, the Seaboard group has foregone pilot consideration and has ambitiously converted 14,080 acres to water injection. Of the presently developed acreage, 150,000 to 175,000 acres appear susceptible to pressure-maintenance operations, by means of water injection. The fringe areas, of lesser permeability and wider spacing, are likely prospects for gas-injection operations.

The total oil productive area approximates 380,000 acres; however, the commercially productive area—presently defined by drilling—ranges from 250,000 to 275,000 acres. The current withdrawal rate from the field approximates 100,000 b/d of oil. Cumulative oil production to January 1, 1957 was just over 49 million barrels. A total of 1,680 wells was capable of producing oil from the Cardium reservoir on that date.

Cardium Reservoir Characteristics: The Pembina field is a large stratigraphic trap, embracing nearly 600 square miles, and located approximately 70 miles southwest of Edmonton, Alberta. Present reservoir limits are determined by the absence of permeability and porosity, with the productive area extending 30 miles in length and 20 miles in width. Structurally, the reservoir dips to the southwest at a rate of 30 ft to 40 ft per mile. The average depth of the reservoir is 5,000 ft subsurface, in the central reaches of the field.

Geologically, the Cardium formation is Cretaceous in age, and is positioned in the Colorado group.

The producing interval within the Cardium formation is a very five-grained sandstone, having a net productive thickness which will average 17 ft to 20 ft throughout the field. Characteristics of the Cardium sand are, to a large extent, dependent upon the shale and silt content of the producing interval. Underlying the sand section is 35 ft to 50 ft of sandy shale which is porous and contains oil, but is nonproductive because of lack of permeability. Overlying the sand section is a conglomerate section. This section is extremely erratic in thickness, varying from a few inches to 15 ft in localized areas.

The porosity of the productive interval will average 16% of the bulk rock volume throughout the developed area of the field which is commercially productive. Average permeability of the fringe areas is in the order of 2 to 3 millidarcys, increasing to 50 to 60 millidarcys in the better portions of the reservoir. Field average permeability will be in the range of 15 to 20 millidarcys.

Oil-base core data obtained throughout the field indicate that the Cardium reservoir is oil-wet. Analyzed samples, having in excess of 10 millidarcys permeability, contain 5% to 8% water saturation. Including all permeability ranges, the weighted average connate-water saturation is in the order of 10% of the reservoir pore space. The fluid properties are variable, but the bulk of the reservoir was undersaturated at original conditions. Original pressure at a datum plane of 2,200 ft below sea level was 2,700 psig, and the saturation pressure approximated 1,700 psig. At the saturation pressure, the formation-volume factor of the oil was measured to be 1.26, the viscosity was 1.09 centipoises, and contained 478 cu ft of gas in solution per stock-tank barrel of oil.

Why Early Pressure Maintenance?: In order to understand the reason that pressure maintenance by means of water injection is being undertaken so early in the Cardium reservoir of Pembina field, a brief discussion of the primary producing mechanism is required.

Plant "A" No. 1 for water injection at Pembina's pressure-maintenance project.

Pump and engine bases at plant under construction for water injection at Pembina.

With Water Injection

By Jack Wahl

The primary producing energy in the Cardium reservoir is expansion of gas originally dissolved in the reservoir crude. No external energy source, in the form of a gas cap or acquifer, has been penetrated in the Cardium reservoir. Should an acquifer or gas cap be found connected to the Cardium sand, the reservoir characteristics of the lengthy structural closure, and the low permeability, preclude the ability of either media to support reservoir pressure. Since the producing system is predominantly oil, as a result of the low connate-water content, it has a high shrinkage per pound drop in reservoir pressure. As production is withdawn from an oil reservoir, the pressure decline is a result of voidage created by producing the oil and by shrinkage of the oil remaining in the reservoir. When the pressure declines, the gas evolved from the remaining oil must fill the void space caused by both oil production and oil shrinkage. In a low-water-content producing system, therefore, a substantial gas saturation is created after a small fraction of the original oil-in-place has been recovered. When both gas and oil co-exist in the reservoir, the ability of the oil to flow through the reservoir is substantially curtailed. With increasing gas saturation, the pressure transmissibility of the reservoir also rapidly deteriorates. Since conversion of alternate rows of 80-acre-spaced wells will result in a 160-acre 5-spot injection pattern, the wide spacing, coupled with the low permeability in much of the area, makes it mandatory that all efforts to effect pressure maintenance in the reservoir be undertaken at, or near, saturation pressure with all reservoir conditions favorable.

Benefits From Water-Injection Program: Pressure maintenance by means of water injection will increase the ultimate oil recovery from a reservoir by a factor of 2.3 over primary depletion.

If water-injection operations are instituted at, or near, saturation pressure, more of the low-permeability area can be effectively flooded on the 160-acre, 5-spot pattern. A prolonged delay will require infill-development if a water-injection program is installed. With pressure maintenance by water injection, the productive capacity of the reservoir can be sustained longer than by the primary energy in the reservoir.

An impressive economic incentive exists for installation of a water-injection program. Graphical comparisons of the economics of both programs are presented in Fig. 1 and 2. These data are applicable to the Seaboard-Great Plains-Baysel-Honolulu-Merrill jointly owned acreage in the

JACK WAHL is vice president and resident manager of James A. Lewis Engineering Ltd., in Calgary. He was born in Springfield, Ill., and graduated in petroleum engineering from the University of Tulsa. He spent three years as petroleum engineer with The Atlantic Refining Co.—thereafter joined James A. Lewis Engineering Inc., in Dallas, as consulting petroleum engineer.

He moved to Calgary in July 1956, as vice president and resident manager of James A. Lewis Engineering Ltd. He has conducted engineering analyses throughout the United States, Mexico, and Canada, and has prepared the original study of pressure maintenance with water injection for the Seaboard-Honolulu-Merrill-Great Plains-Baysel group. He is now retained by that group for field supervision of the installation of the water-injection system.

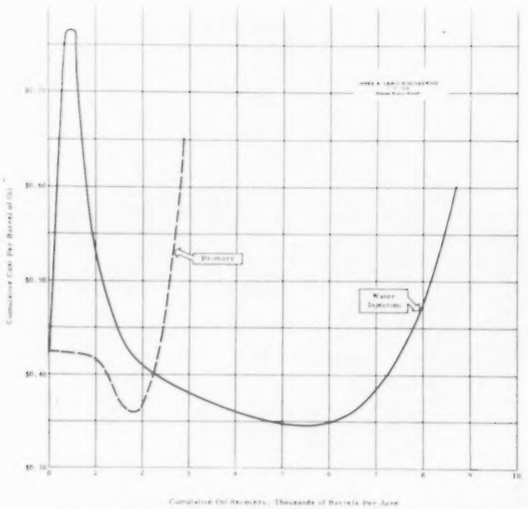


Fig. 1 Cumulative costs per barrel of oil produced as a function of cumulative oil recovery per acre, Seaboard Group Properties, Cardium Sand—Pembina Field, Alberta, Canada.

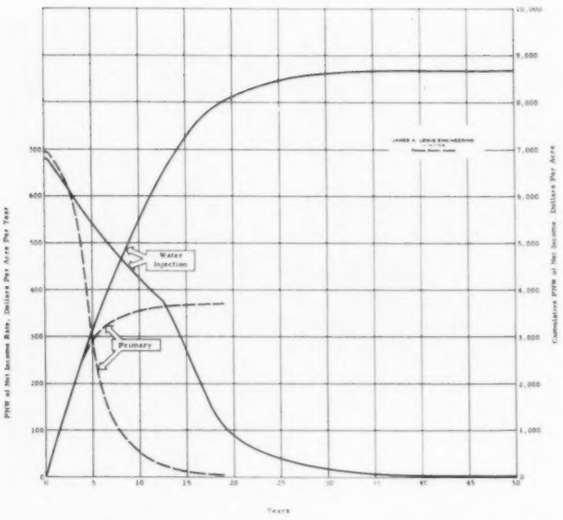


Fig. 2 Predicted income performance, Seaboard Group Properties, Cardium Sand—Pembina Field, Alberta, Canada.

southeast sector of the Pembina field, and are available as a result of a comprehensive engineering analysis prepared on 11,200 acres in this area. Average properties of the Seaboard group acreage are as follows:

Porosity (%)	16.7
Permeability (millidarcys)	14.7
Connate water (%)	7.5
Thickness (feet)	23.1
Number of wells	140
Formation-volume factor (barrels per barrel)	1.247
Original pressure (psig)	2,665
Saturation pressure (psig)	1,700
Solution gas-oil ratio (cu ft per bbl)	478
Viscosity at saturation pressure (centipoises)	1.09

Fig. 1 relates the cumulative cost per barrel to the cumulative oil recovery per acre. Early per-barrel costs are high, since they reflect capital expenditures required to effect either program, exclusive of initial development expense. The most significant feature of this graph is that the cumulative per-barrel cost for primary operations exceeds the cost of water-injection operations, after a cumulative recovery of 2,250 bbl per acre.

Fig. 2 presents the relationship between the yearly rate and cumulative value of present net worth of future net income per acre for primary and pressure-maintenance operations, when plotted as a function of time. The cumulative present net worth of net income per acre, under primary depletion, totals approximately $3,700 over a 19-year producing life. Under the water-injection program, the comparable value approaches $8,700. From these figures, capital expenditures must be deducted, which amount to $150 per acre for primary operations and $250 per acre for water-injection operations. Also excluded from either program is the initial development expense of $1,000 per acre.

The most striking feature of Fig. 2 is the fact that the cumulative present net worth of future net income obtained during the 19-year primary history is exceeded by the water-injection program in about 7 years.

Based on the conclusions derived from the engineering analysis, the Seaboard group requested the Petroleum and Natural Gas Conservation Board of Alberta to approve installation of the pressure-maintenance program. Approval was obtained in May 1956, and the project installation was initiated in July 1956. Water was injected into the first well on November 15, 1956. The entire project was completed in February 1957, and involved 14,080 acres and 176 wells. Alternate rows of producers were converted to injection, resulting in 88 injectors and 88 producers, on a 160-acre 5-spot pattern.

Although the winter was generally mild in the Pembina area, much of the physical installation and well conversion was accomplished during subzero temperatures which ranged down to −35 F.

The injection system installed consisted of a central plant, with a distribution system which permits separate metering of water injected into each injection well. Six plants serve the 14,080 acres, with the smallest plant serving 960 acres and the largest plant serving 3,360 acres. The plants were constructed from the same basic design, being sized with pumps and associated equipment to fit the area being served. All lines in the distribution system were buried 8 ft below the surface, to prevent mid-winter freezing. As an additional operating precaution against freeze-ups, the injected water is heated to 120 F before it leaves the injection plant.

Each plant is completely housed in an insulated, metal building. Some of the more important features inclosed in the plant buildings are as follows:

1. Two, 1,000-bbl., galvanized tanks: One tank is used for raw-water storage and the other for filtered-water storage. Each tank is equipped with a 4,000,000 Btu direct-fired heater, capable of elevating the water to a temperature of 120 F.
2. Pumps and engines: A horizontal plunger-type triplex pump, capable of delivering 2,000 bbl of water per day at 360 rpm and 2,300 psi. The pumps are coupled directly to a gas-driven one-cylinder 105-hp engine.
3. Filters: Two 8-ft pressure filters, using anthrafilt as the filtering media, are included in each plant.
4. Alarm panel: A warning system, employing lights and horns to pinpoint malfunction of each part of the overall plant operation, is in each plant office.
5. Centrifugal pumps are utilized to transfer water, which includes filtration, backwashing of filters, and flood of the suction on the pumps.

To comprehend fully the significance of the pressure-maintenance program by water injection in the Cardium reservoir in the Pembina field, the reserve gain to be effected by this program should be examined. The ultimate primary reserves of the presently developed area will approach 520,000,000 bbl. Additional oil, recoverable by means of pressure maintenance with water injection, is estimated to be 560,000,000 bbl. Total recoverable oil, therefore, will be in excess of one billion barrels. The limits of this remarkable reservoir are not yet defined to the north or east, and could spill out in either direction, when sufficient exploratory drilling is extended into these areas.

To place the field under water injection to maintain pressure, the Pembina operators will invest approximately $35,000,000.

C. A. L. Hogg

Saskatchewan Government Policy and Regulation

*By C. A. L. Hogg**

Land-Ownership Patterns and Historical Background: The entire area of Saskatchewan totals 251,700 square miles. Pre-Cambrian rocks occupy the surface of the northern unsurveyed one-third of the province comprising an area of 90,000 square miles. This area is, therefore, of no interest to this discussion, although its mineral lands are all provincially owned.

South of the pre-Cambrian area there are approximately 63,000,000 acres which are regarded as a potential petroleum-bearing area and over which exploration for oil and gas is currently active.

Within this 63,000,000-acre area there are approximately 24,000,000 acres of private lands scattered throughout in a checkerboard pattern with the Crown lands—although, in general, the freehold lands are confined to the south-central and eastern parts of Saskatchewan. These freehold lands are held mainly by the Hudson's Bay Co., Canadian Pacific Railway System, Canadian National Railway System, early colonization companies, and individual owners. The majority of this land has been leased for oil and gas development. In addition, there are 1,595,019 acres of land which are owned by the federal government, largely in Indian reserves.

This mineral-right ownership pattern has been shaped by a varying series of historic events, some of which date back 250 years. The first legal document affecting Saskatchewan was the Hudson's Bay Co. charter from King Charles II in May 1670, granting to the company, all lands and minerals in that area adjacent and tributary to Hudson's Bay, designated Rupert's Land.

Later, the Canadian government arranged for the purchase of Rupert's Land from The Hudson's Bay Co., which relinquished it by deed of surrender dated November 19, 1869, and Rupert's Land and the North West Territories were brought into the Canadian Federation of Provinces on June 23, 1870, which ended the era of Hudson's Bay Co. rule in Western Canada.

Part of the price Canada paid the Hudson's Bay Co. for Rupert's Land was one-twentieth of the land available for settlement in that vast territory extending from the Lake of the Woods and Lake Winnipeg to the Rocky Mountains and lying south of the North Saskatchewan River and north of the international boundary. This amounted to 1,152 acres per township, and was made up by disposition of 2 sections in every fifth township, and 1¾ sections in all other townships.

Early in 1860 there grew a movement for the union of the eastern British colonies with the western one. Manitoba joined the union on July 15, 1870, and British Columbia on July 20, 1870, at which date all the country from the Atlantic to the Pacific north of the present international boundary was Canadian.

The basis for British Columbia's joining the union was the promise of a railroad to the Pacific Coast. The year 1871 then ushered in the railway-building era with its attendant land policies which did more than anything to shape the present pattern of mineral-rights ownership in Saskatchewan today.

A number of railway and colonization companies were set up during this period, and areas were set aside wherein the companies could choose the odd-numbered sections fairly fit for settlement, to satisfy railway land subsidy commitments.

The agreement with British Columbia for a railway to the Pacific was confirmed by the first Canadian Pacific Railway Act of June 14, 1872. However, the railway had to pass through Ontario and British Columbia, both of which controlled their lands and natural resources. Consequently, the Canadian government used the land under its control in Manitoba and the Northwest Territories, with the result that these areas assumed practically the full burden of railway land subsidies. The province of Saskatchewan was formed in 1905 out of the Northwest Territories, although the federal government retained control of all resources until October 1930.

The loss to the Prairie Provinces aggregated 31,780,016 acres of land, including mineral rights—with British Columbia contributing 1,580 acres.

The burden on Saskatchewan was particularly heavy, as not only did it provide nearly half the acreage of the whole federal land-grant system, but only 24.4% of the railway mileage was built within its borders.

Early agricultural settlement also shaped the mineral-ownership pattern in Saskatchewan due to the fact that until October 31, 1887 minerals were included in a homestead entry located west of the third meridian and, until January 11, 1890, if the homestead entry was located east of the third meridian.

Titles are held under the Torrens system, and there is only one method of determining ownership of mineral rights in Saskatchewan and that is by searching the certificate of title on file in the Land Titles Office. The province is divided into 10 land registration districts, and the registrar of the one in which a particular parcel is located is contacted for information. This system is designed to do away with the necessity of examining every deed of conveyance which ever has been issued on any parcel in order to find out what the present owner enjoys; one simply inspects the certificate of title, and from it any ordinary person—not necessarily skilled in law—may determine the rights of the registered owner together with the history of any encumbrances which have been registered against it.

Oil and Gas Regulations Governing Acquisition of Lands: In October of 1930, when the resources were transferred to provincial authority and control, the Department of Natural Resources was established. The almost simultaneous onset of the depression retarded mineral development and exploration, and then followed World War II. Therefore, it was not until 1949 that broad-scale oil and gas exploration took place in the sedimentary belt of Saskatchewan.

The first regulations for the leasing of Crown lands were established in 1931. Exploration permits for areas up to 250,000 acres in a block were not developed until

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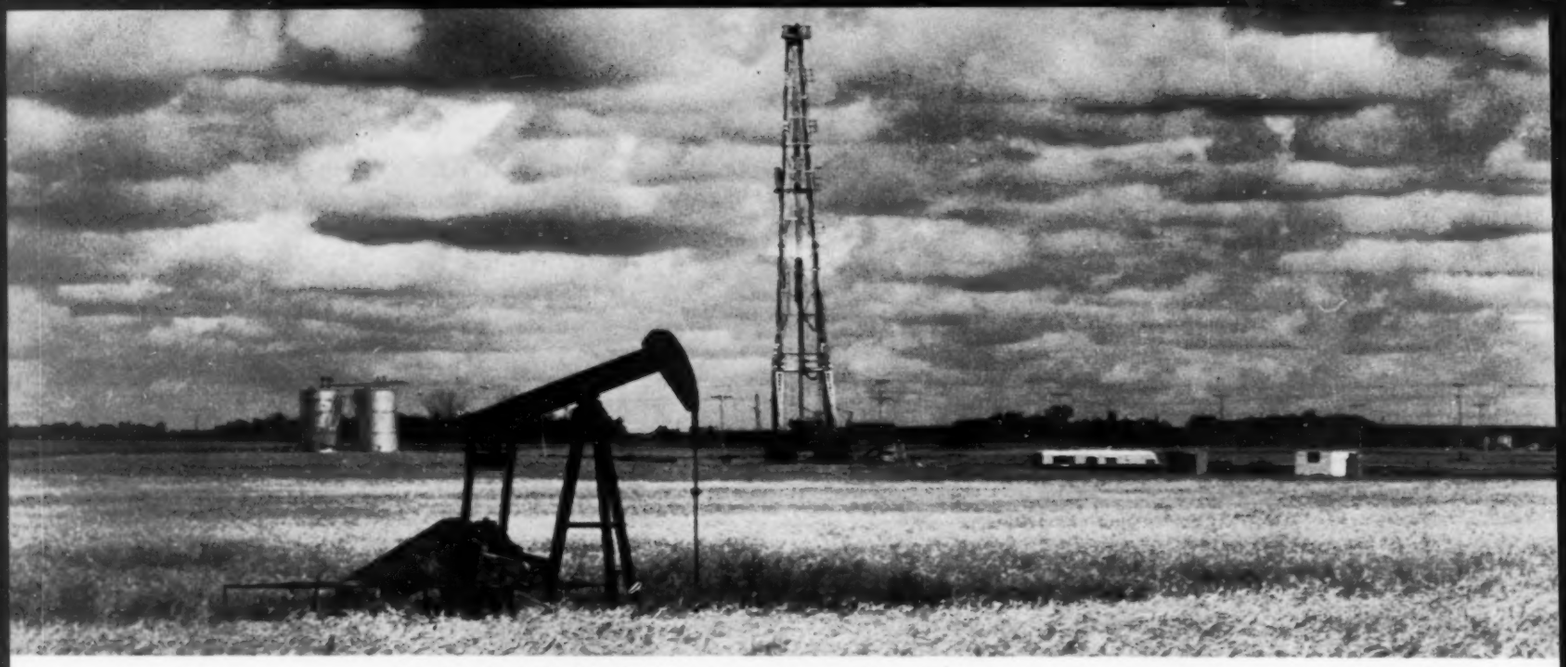


Telephoto shot of the Coleville field, with oil equipment amid the waving wheat ready for harvest. (Photo courtesy of Royalite Oil Co.)

1945. Various changes in the methods of disposition have taken place to keep up with development and exploration techniques, resulting in a set of regulations which have been pretty well standard since 1951.

Land disposition in Saskatchewan is divided into three distinct methods, viz., exploration permits, drilling reservations, and leases.

Exploratory permits may be taken on areas up to 100,000 acres for a term of 3 years—with an annual rental of 2 cents per acre the first year, five cents per acre the second, and 10 cents per acre the third. However, there are work commitments of 20 cents per acre on any approved type of work the first year; 40 cents per acre, with a minimum of $15,000 in actual drilling, the second; and 60 cents per acre, with a minimum of $15,000 in actual drilling, the third. Work must commence in 90 days. In the northern part of Saskatchewan a certain amount of grouping of permits is allowed.

Drilling reservations are limited to a maximum of 20,000 acres for a term of one year, with provision for two one-year renewals. The fee for the issue of such a reservation is $250, and the annual rental is 50 cents per acre. However, it is necessary to drill a well on the area to a specified depth. If the work commitment has been met, the holder may convert to lease on 50% of the reservation on an alternate choice basis.

Leases are obtained by conversion from permit; conversion from drilling reservation; or by direct sale of open Crown land in proved or semi-proved areas. They may range in size from a minimum of 40 acres to a maximum of 23,040 acres, and the term is approximately 21 years. There is an application fee of $10 and an annual rental of $1.00 per acre per year. Drilling must commence within 6 months of a notice by the minister or 60 days after notice of offset has been sent. A refund or rental may be earned during the first, second, or third years by drilling a well in a wildcat area at a specific distance from producing wells.

In converting to lease from exploration permit, the operator may select rectangular lease blocks in a township, but no side of a block in any rectangle may be longer than 3½ miles. A corridor of one mile must be maintained between lease blocks, but any two blocks may have a common corner.

Where no side of a block is longer than two miles, 60% of the lands may be leased in the township.

Where two sides of a rectangular area are more than two miles but not more than three miles, up to 50% of the Crown land may be leased in the township.

Where two sides of a rectangle are more than three miles, but not more than 3½ miles long, 40% of the Crown lands may be leased in the township.

In an endeavor to resolve any conflict between the operator and the owner of the surface rights, regulations were introduced in 1947. These regulations set out the manner and terms on which the compensation was to be calculated. The compensation was based on a formula which took into consideration the assessed value of the land, soil type, long-term average yield, and price of wheat. These regulations, with minor modifications, are still in effect.

For disposition of Crown lands for exploration purposes, the province is divided into two sections—the southern, where competition is keen; and the northern, where it is rare that we get two applications covering the same land. In the southern section, lands for exploration are put up for disposition on a competitive basis; while north of the dividing line they are disposed of on a first come, first served basis.

The Crown reserve provision was brought into effect in 1946. At that time an area equal to 15% of the total Crown land in any permit was set aside on a 640-acre section checkerboard basis for Crown reserve. The percentage was increased to 25% in 1949. In other words, the Crown reserve parcels were predetermined. This gave rise to the problem of seismic anomalies, falling largely on a Crown reserve section which involved negotiations for the exchange of acreage. For this reason, that system was abandoned in 1951 in favor of a new one whereby the Crown reserve is not designated in the permit, but is determined by the choice of the operator when he goes to lease; i.e., 40%, 50%, or 60% of the Crown lands in the township are set up in Crown reserve, depending on the size of the lease block which the operator chooses.

Therefore, it may be said that there are two systems of Crown reserve in existence—the 25% system, which is still in operation on those leases taken out prior to 1951 and in which the 25% Crown reserve is frozen into the lease pattern; and the system where the Crown reserve is not determined until the operator goes to lease.

As leases are developed and discoveries made, the Crown reserves are advertised for disposition by competitive bidding on a cash bonus or net royalty basis (a net royalty bid is an offer of a percentage of the net proceeds of the operation after payout).

At the present time there is a total of 29,794,392 acres under active exploration, 23,090,631 of which are held under permit and 6,703,761 under lease and drilling reservation.

Oil and Gas Conservation: Prior to 1952, the Mineral Resources Act authorized the Department of Natural Resources, in general terms, to license and control the search for petroleum and natural gas in the province. However, this control was essentially applicable to drilling on and production from Crown lands, and the generally accepted rules of conservation were neither spelled out nor enforced.

In 1952 the Oil and Gas Conservation Act was passed, after lengthy discussions of its content with the Canadian Petroleum Assn. and with experts in this field of legislation throughout the continent. The regulations under this act were also drafted with the cooperation of the CPA in 1952, and were put into effect in February 1953. The act and regulations were primarily based on the model suggested by the Interstate Oil Compact Commission—with revisions as required by provincial policy and other local conditions—and spelled out for the first time in the province; definite rules on well spac-

ing, daily allowables, unitization, pooling, prevention of waste, and proper abandonment of wells.

Succeeding years have tested nearly every phase of the act and regulations, and minor changes required from time to time to meet particular circumstances were consolidated in a revision made effective January 1, 1957. The salient items in our conservation laws as presently defined may be briefly summarized as follows:

Well Spacing: Standard spacing is 40 acres, but any field may achieve closer or wider spacing after due inquiry held by the Petroleum and Natural Gas Branch of the Department of Mineral Resources. Wider spaced wells do not obtain larger allowables until production and pressure data justify such increase.

Daily Allowables: Each oil well is given a maximum permissive rate of production which is based on reserves in place within the drainage unit. Overriding this rate, in the case of poor wells, is an economic allowable which is based on depth of the productive zone.

Unitization is encouraged wherever possible, and several oil and gas production unit plans are now in operation. The act provides for compulsory unitization upon the recommendation of the Oil and Gas Conservation Board, with no stipulated minimum percentage of voluntary agreement among the operators involved.

Pooling may be either voluntary or compulsory if the latter is recommended by the Oil and Gas Conservation Board.

Waste: The department is authorized to prevent waste, such as excessive flaring of oil-field gas. In four instances to date, the department has ordered the collection and use of such flare gas.

Secondary Recovery: Programs are encouraged as much as possible. All salt-water-disposal or gas- or water-injection programs must be approved by the department after inquiry before being put into effect. Several water-flood plans and one gas-injection (pressure-maintenance) plan are in operation in the province at the present time.

Abandonment Programs: All drilling programs are covered by deposits with the department to insure proper abandonment of each producing well or dry hole. The deposit is not refunded until the well has been cemented off to the satisfaction of department engineers and the well site cleaned up to the satisfaction of the landowner.

Reservoir Control: Complete drilling, completion, production, sales, pipeline, and refinery statistics are reported to the department on a monthly basis. All logs, cores, core analyses, fluid analyses, and bottom-hole pressure records are similarly submitted to the department for posterity. The department's field staff and geology reservoir engineering divisions use all of these data to advise the minister, to the best of their ability, on decisions concerning the four vital purposes of the Oil and Gas Conservation Act: (a) to prevent waste; (b) to regulate all operations for the production of oil and gas in such manner that the greatest possible ultimate recovery thereof by prudent and proper operations and practices may be realized; (c) to protect the correlative rights of each owner; and (d) to enable each owner to obtain his just and equitable share of the allowable production of any pool.

Administration: Crown lands and conservation regulations are administered by the Petroleum and Natural Gas Branch of the Department of Mineral Resources, employing a staff of 82, 34% of whom are technically trained as petroleum engineers and geologists.

In the development of pooling plans, unitization, applications for pipelines and gas absorption plants, the matters are referred to the Oil and Gas Conservation Board for consideration and recommendation. The conservation board is a nonadministrative body composed of three members, who hold public hearings on specific questions at the request of the minister of the department.

Oil Production: At the present time Saskatchewan has 2,561 oil wells and 157 gas wells. During the months of December, 83,737 b/d were produced—12.4% of which had a gravity of under 20 API; 43.4% was between 20 and 30 API, and 44.2% was 30 API or over. During that same month, Saskatchewan refineries utilized 1,789,814 bbl, or 57,736 b/d.

There is no proration to market demand in Saskatchewan. The operators have generally developed their own markets; but pipelines and special type refineries to handle production, such as the Great Northern Oil Purchasing Co. refinery at St. Paul and the pipeline system to serve it. The light-oil production from southeastern Saskatchewan finds a ready market in eastern Canada without any problem.

Policy: It is the policy of the government of Saskatchewan that oil and gas resources will be developed by private enterprise, with the government maintaining the position of a royalty and landowner. We believe that a fair share of revenue from the development should be retained for the people of Saskatchewan and, in this connection, it is expected that revenue from petroleum and natural-gas development in the province for the current fiscal year will amount to $18 million, of which approximately $4 million was from permit and lease rentals; $2 million from royalties; and $12 million from bonus bids.

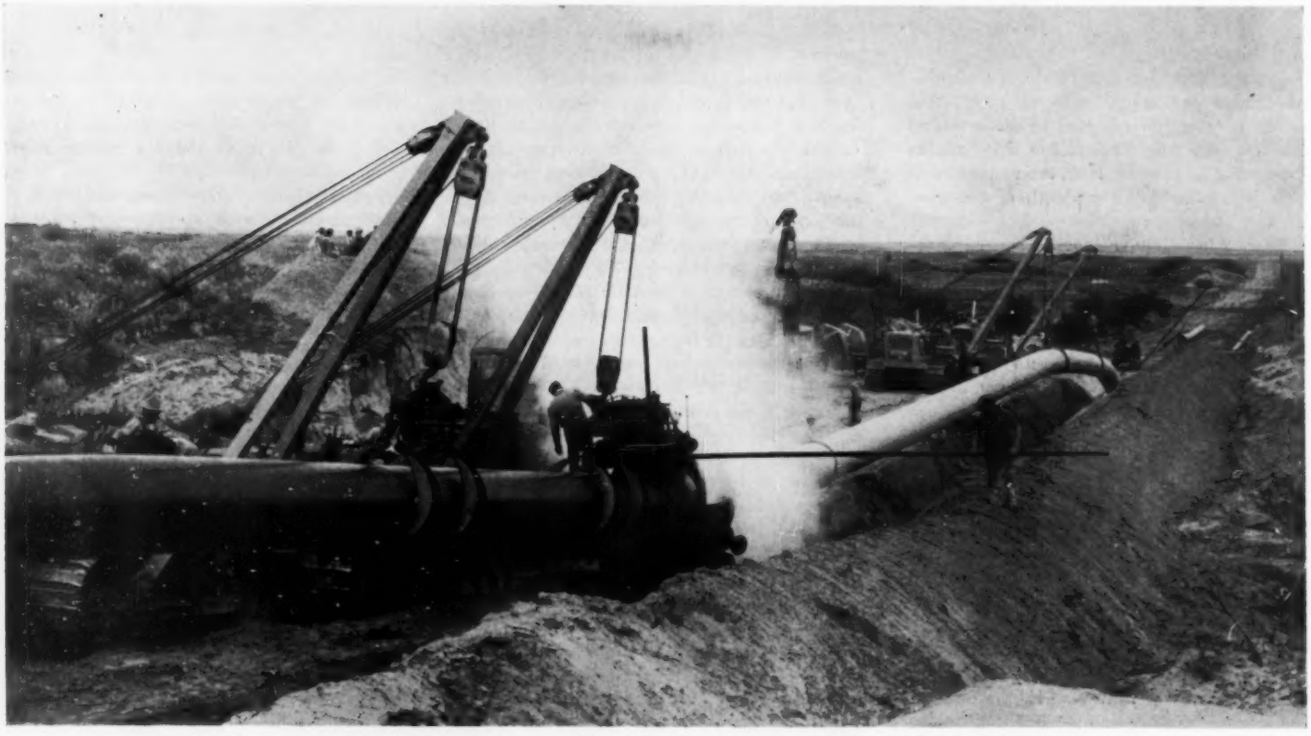
To assist in promoting the development of the petroleum industry, the government, through the Department of Mineral Resources, maintains on file a vast amount of information on exploration in the form of cores, samples, logs, and geophysical maps. Such information has confidential status for a certain length of time, and the geological data are then correlated and released to the industry in the form of reports. END

Setting up drilling rig (Photo courtesy of Cities Service Co.)

Canadian Gas Developments

by Floyd K. Beach

Completion is in sight on the first leg of Trans Canada and Westcoast lines. Based on large gas reserves, Canada is moving into petrochemicals in a major way and increasing gas consumption.



Trans-Canada's 34-inch natural-gas line is being laid through the Great Sand Hills of western Saskatchewan.

Two major gas lines are being completed on opposite sides of Canada. Westcoast Transmission's line is nearly complete on the western edge, while Trans-Canada's first big lap is being completed this year.

Trans Canada Pipe Lines is financed for the prairie leg of its transmission line. Stock offered on the open market was oversubscribed and immediately sold at a premium. The less remunerative section across northern Ontario is to be built by the governments of Canada and Ontario and leased to Trans Canada on a basis which will repay government expenditure over a period of years.

Alberta gas is to be gathered and transmitted to the Saskatchewan border by Alberta Gas Trunk Line, to be picked up there by Trans Canada; and in March the Trunk line stock was put on the market to residents of Alberta at $5.25 per share, with a limit of 100 shares to the person. The offering was oversubscribed about five or six times over, and was selling over the counter before certificates were delivered at from $10 to $13.

Westcoast Transmission has somewhere around two-thirds of its transmission line laid to the Pacific Coast from Peace River country, and should be ready to deliver gas by fall this year. Gathering lines and plant for processing the gas should be ready at the time the transmission lines are complete. A branch line to Trail and communities en route is also to be completed this fall under the corporate name of Inland Natural Gas.

Markets for gas are very elastic subjects. Tentative contracts between a transmission company and a distributor may fix a figure "to take or pay for"; and, before the transmission line is laid, the distributor wants to double the figure. Trans Canada has as yet no permission from the Federal Power Commission to deliver gas to Tennessee Gas Transmission for supply of what looks like a very big, unsatisfied market in the Midwest states; but, from present prospects, the markets along the line in the Canadian prairies, at the Lakehead—possibly to mining ventures across northern Ontario and in the densely settled parts of Ontario and Quebec—will be adequate to fill the pipeline without any delivery to the United States. Present financing did not contemplate such deliveries; so, if the outlet to TGT develops, so much the better off.

Supply of gas appears to be adequate. For Westcoast, Dr. G. S. Hume quoted a report by Ralph K. Davies of October 1955 showing reserves in British Columbia of over 1.8 trillion cubic feet and in Alberta of over 1.5 trillion cubic feet of pipeline gas, and development drilling plus new discoveries since the date of the Davies report are believed to add to that quantity.

A recent report by the Alberta Petroleum and Natural Gas Conservation Board sets established reserves in Alberta as of Sep-

tember 30, 1956 at 18.3 trillion cubic feet, of which reserves considered within economic reach total 16.5 trillion cubic feet. Of this, Trans Canada has been authorized to take 4.35 trillion cubic feet, Westcoast Transmission and Peace River Transmission 1.013 trillion, and Canadian Montana about 0.3 trillion cubic feet.

The conservation board's report goes on to show a discovery rate for gas of six billion cubic feet per wildcat well drilled, with a projection over the next 30 years that will bring disposable reserves to about 42 trillion cubic feet by 1986. The report shows an increase in reserves between June 1955 and September 1956 of 2.7 trillion cubic feet. About half of the increase is attributed to new discoveries and half to expansion of previously known reserves.

"The discoveries in the Windfall, Hussar, Wimborne, and Crossfield areas account for more than half of the increase due to new discoveries; whereas the increases in the previous reserve estimates for Harmattan-Elkton, Westerose South, Medicine Hat, Homeglen-Rimbey, Bindloss and Savanna Creek account for the majority of the increase due to expansion of previously known reserves. Partially offsetting the increase in the latter classification are substantial decreases in the reserves previously attributed to the Pembina and Pincher Creek fields."

Consumption in Alberta will grow with time, and demands within the province are projected in the report. There is good prospect that present allocations to the exporting agencies can be increased as new reserves develop, if we read correctly the graphs of projected discoveries and use within the province.

During the past year a plant at Medicine Hat was put into service, and is now turning out fertilizer made largely from natural gas. This adds to the fertilizer supply turned out by Cominco at Calgary, using natural gas, and the plant at Trail, B.C., using hydrogen electrolytically. Fertilizer is also produced by Dow Chemical at Sarnia, Ontario.

In 1956 Midwestern Industrial Gas laid a pipeline from its Alexander field (northwest of Edmonton) to Wabamun, to supply a new thermal electric plant built by Calgary Power, in which operation started in the fall of 1956. North Canadian Oils extended the pipeline from Wabamun to Hinton, where a pulp mill is under construction. En route this line supplies fuel to a pump station of Trans Mountain Pipe Line at Bickerdike with an expected demand of 1,250 mcf daily when looping from Bickerdike to Jasper is completed this year.

Northwestern Utilities Ltd., a company distributing gas from its own wells in Viking-Kinsella and Fort Saskatchewan fields, has taken over distribution of gas from the Hinton line for domestic consumers in Edson and some other towns along the line, as well as other places along earlier transmission lines.

Canadian Western Natural Gas Co., which is affiliated with Northwestern Utilities, has laid transmission lines to serve towns between Red Deer and Calgary which previously had been without gas, and has extended services to several communities not far from Lethbridge.

Between the two major Alberta gas distributors, some 25 communities either have or shortly will have gas supplies for the first time.

Savanna Creek: Northern Natural Gas, an American company which is a partner in the development of Savanna Creek, the only Rocky Mountain field in Canada where gas has been found, announced during 1956 that it had contracted with Westcoast Transmission to deliver gas through a pipeline projected westward. Before that project could become a reality, application would need to be made to the Alberta Conservation Board for permission to export, and federal approval would also be needed. To date no such applications have been made.

Byproducts: Sulfur—Early deliveries to Trans Canada will be largely from fields having nonassociated (dry) gas, needing removal only of water vapor and perhaps carbon dioxide, but with extensions of Trunk Line to fields farther west there will be much sulfur and LPGas to remove. In our *World Petroleum* (May 1954) we forecast a daily fixing of sulfur of the order of 1,800 tons. Without reviewing that estimate in detail, we can comment that since that time more sulfur gas has come into the picture. At Taylor Flats, B.C., a plant to process gas for Westcoast Transmission will have a sulfur plant now being built by Jefferson Lake Sulphur Co. which will turn out an estimated 300 tons daily, and Jefferson Lake Sulphur Co. has just negotiated a deal with Mobil Oil with plans to turn out 350 long tons daily from a plant close to Calgary. Redwater gas is now being gathered, and its sulfur fixed; but the quantity is not important in relation to other supplies. These recoveries are additional to the 1,800 short tons daily covered in our earlier estimate. The fly in the ointment is freight costs from Alberta to consumers. Fortunately, not all the sources of sulfur will be developed simultaneously; and, as new sources develop, there is every hope that outlets will be negotiated and that freight on a low value product as far as the lake head will be adjusted to a price related to its value, particularly when the supplies are in large enough quantity to make handling remunerative. By that time the St. Lawrence seaway will probably be operating, and deliveries to lake head will be about equivalent to deliveries to seaboard. Some sulfur has been going to paper mills at the Pacific Coast, and some goes to the uranium mines for leaching. A sulfuric-acid plant at Ford Saskatchewan uses sulfur produced in Alberta, and a sulfur plant built by British American Oil Co. at Pincher Creek is in operation and is sending its sulfur to Medicine Hat for use in making ammonium sulfate for fertilizer.

Liquid petroleum gas is another problem. In Texas and in California, butane has been the preferred product, for it does not require as strong containers as propane. Normal butane boils at about the same temperature as water freezes, so it would present problems in our Canadian climate where frost predominates from October on—very often into May. For this reason, propane is the preferred Canadian LPGas, for it boils until the temperature reaches nearly −45 F. By the same token, propane is a problem to store. Aboveground storage is so costly in relation to the value of its contents as to preclude storage for more than a few days, and that rules out carrying over a summer surplus to winter.

Much of the butane recovered to date in Alberta has gone to drilling rigs and to Canadian Chemical Co., where it goes into acetate fiber. Some has been returned to the gas cap of oil fields. Propane distributors have steadily increased their sales, and hope to develop a market for its use in farm tractors to take up summer surplus. One large distributor tells us he was able to look after all his customers this winter without importing, and last summer had to flare not over 100,000 gal. The consumer pays 15 to 18 cents per Imperial gallon, depending on how far he lives from the plant. Some other distributors have had to import this past winter in order to look after customers.

What will happen when Trans Canada gets into full swing will be another matter, for the recovery of propane and butane will be on a far greater scale.

A plant at Red Deer has been announced, to use butane for manufacture of butadiene, a constituent of synthetic rubber. Polymer, the big company with an integrated plant at Sarnia, Ontario, is to build the plant. If Alberta could get a plant or plants like the one of Dow Chemical at Sarnia, much propane would find its way into ethylene glycol and other derivatives.

Saskatchewan: In Saskatchewan, the government set up the Saskatchewan Power Commission as a Crown company. Among other activities, it handles gathering, transmission, and distribution of gas within the province. It now gathers gas from fields around Coleville, and supplies a number of communities in the north. Very recently, there was an announcement that mains are to be laid in the city of Regina, and apparently it is planned to take gas from Trans Canada—although a contract has not yet been completed.

We understand SPC plans to gather gas in several southerly fields, including Hatton field, an eastward extension of the Medicine Hat field of Alberta; and an application has been before the Alberta Conservation Board for permission to extend gathering lines into Alberta, where Britalta has proved up considerable reserves. The city of Medicine Hat raised objections to approval of that application, and no decision in the matter has been announced.

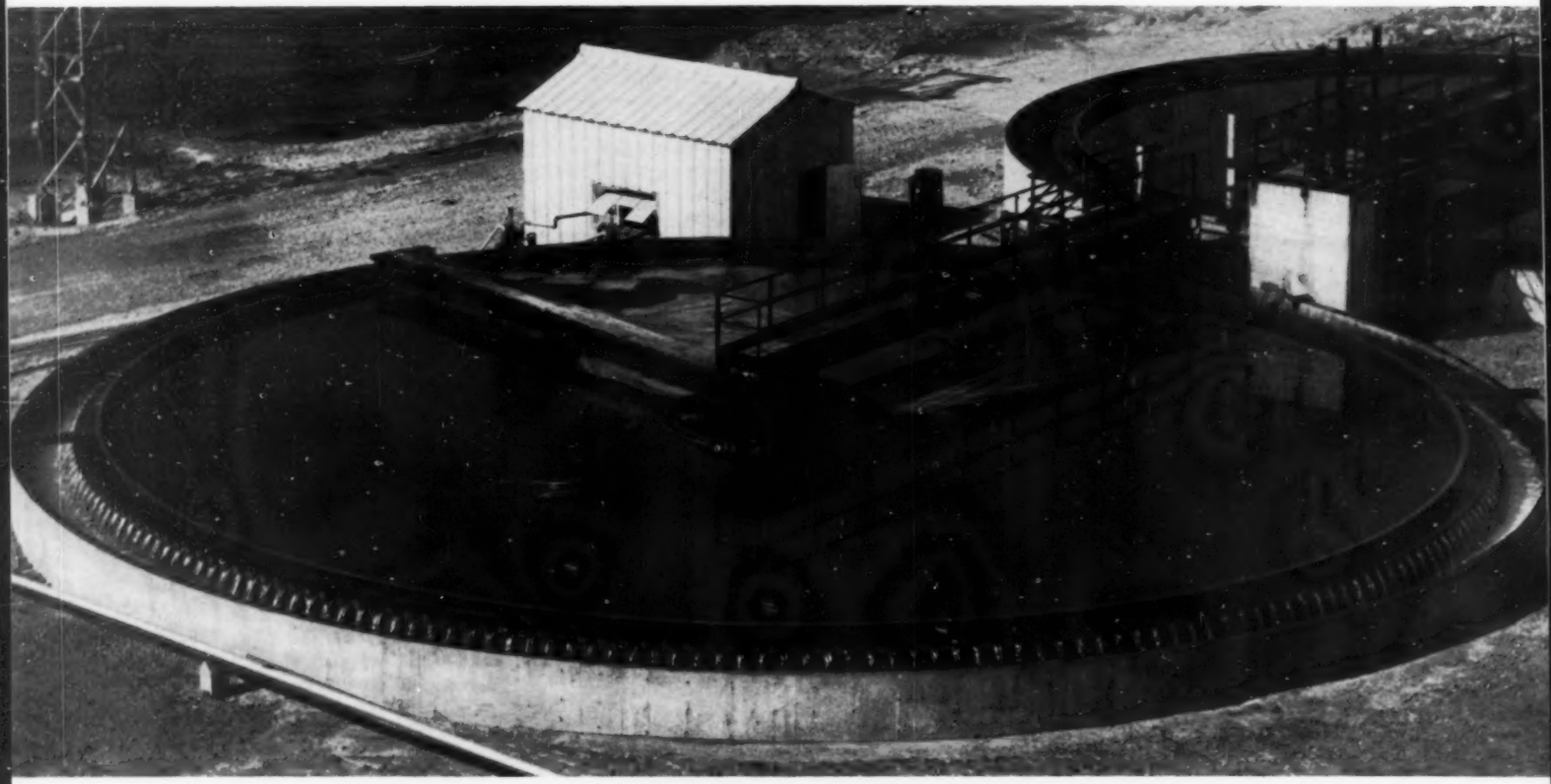
Manitoba: The city of Winnipeg is in part supplied with heat from a central heating plant which pipes steam to houses, and the bills for heat are based on metered con-

(Continued on page 118)

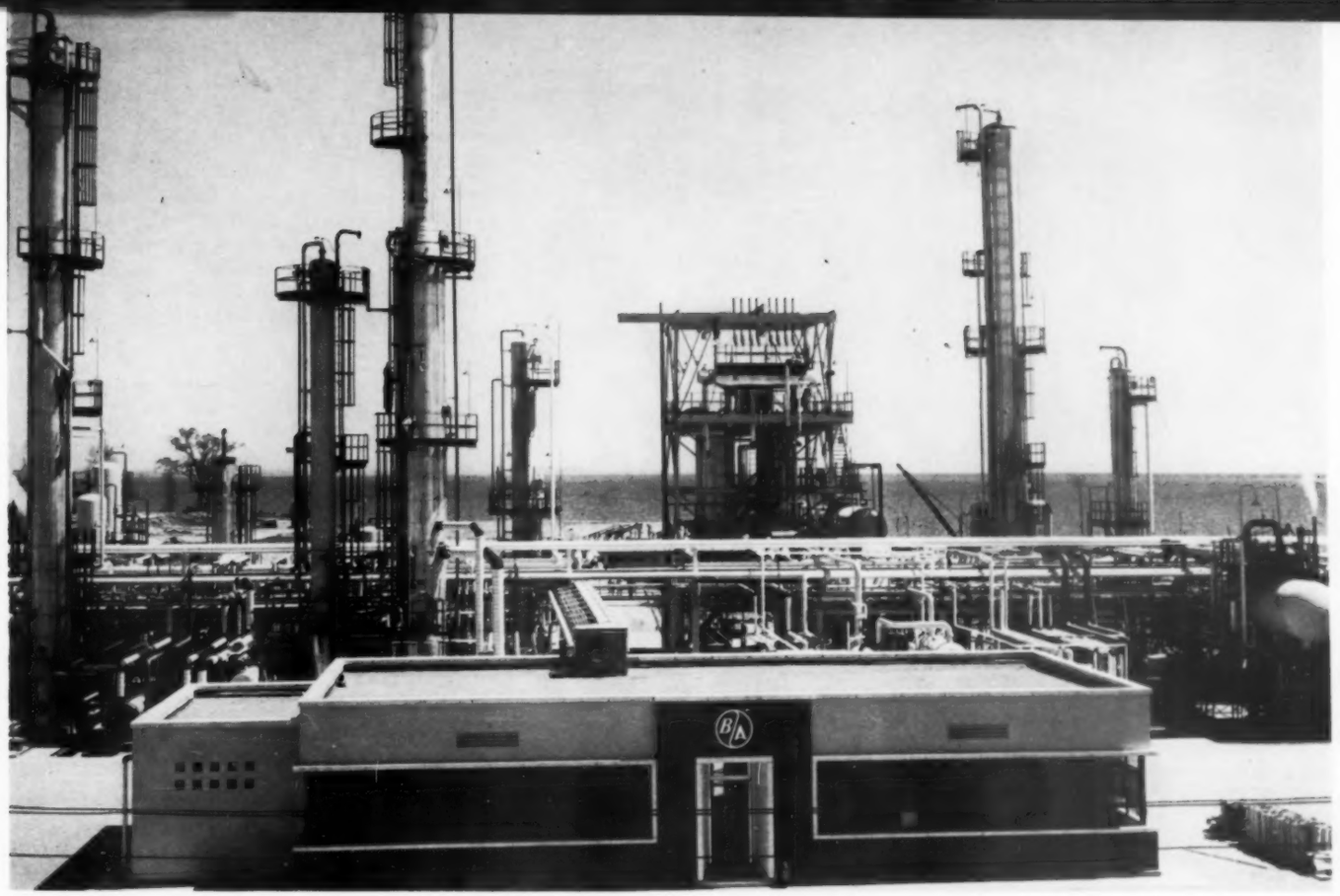
1957 REFINERY CONSTRUCTION CENTERS

in Ontario and Quebec

Extension of the Interprovincial has stimulated a large refinery building program in the Toronto area which is expected to bring capacity there above 100,000 barrels. Another new major enters Montreal.



These large circular separators at Imperial Oil's refinery near Halifax, N.S., remove oil from cooling water, which is then returned to the harbor. Some 36 million gallons of salt water per day can be taken out of the harbor by pumps, located about 16 ft below high water.



British American Oil's Clarkson, Ontario, refinery sh owing control house in foreground and gas-recovery and cat-poly towers in background. Construction of a new 10,000-bbl catalytic reformer unit and additional new crude processing facilities are under way at present which, when completed late in 1957, will trible the refinery's capacity.

CAPACITY of Canadian oil refineries in 1956 increased 53,000 b/d, to 704,000 b/d. The increase was somewhat smaller than in 1955, and failed to keep pace with the increase in domestic demand.

New investment in refining properties during the year was about $80 million, of which some $50 million went to increase crude charging capacity and $30 million for product improvement—largely to increase octane ratings of motor fuel.

Construction projects for 1957 total about 87,500 b/d, but not all of this new crude capacity will be onstream by the end of the calendar year. Assuming that demand continues to increase at its present rate, Canada will find it necessary to increase its imports of finished products in the near-term.

Of the proposed new additions to crude capacity, more than 75% will be centered in Ontario and Quebec. Only four relatively small projects are being undertaken in the west.

Largest new project in sight is the 30,000 b/d refinery which will be built at Montreal by British Petroleum Co. Ltd. The plant will cost about $30 million when completed, which cannot be before late 1958.

British Petroleum purchased an interest in Triad Oil Co., of Calgary, a year or so ago to obtain a foothold in western production, but heretofore has had no refining or marketing operations in Canada. The company has centered its activities in the Eastern Hemisphere.

BP will begin building a marketing outlet for its new refinery in the immediate future. Sites for retail stations have been purchased in Montreal and elsewhere in Quebec. Construction of stations on these will begin this spring.

For the refinery itself, BP has obtained a 600-acre site in Ville d'Anjou, about three miles north of the St. Lawrence River. An oil dock will be built on the river for unloading crude supplies. Because of its very large production in the Middle East, it is assumed that raw materials for the plant will be imported from that area.

Completion of the BP refinery at Montreal will bring capacity of plants in the immediate vicinity of that city to 270,000 b/d, which is by far the largest group in the dominion. Most recent new plant completed in the area was the 20,000 b/d plant built two years ago by Canadian Petrofina. Imperial Oil Ltd., Shell Oil Co. of Canada, McColl Frontenac Oil, and British American have been enlarging capacity of their plants there on a more or less steady basis for many years. Imperial's crude capacity now is up to 65,000 b/d; Shell now has a capacity of 60,000 b/d; McColl Frontenac has 55,000 b/d; and British American 40,500 b/d.

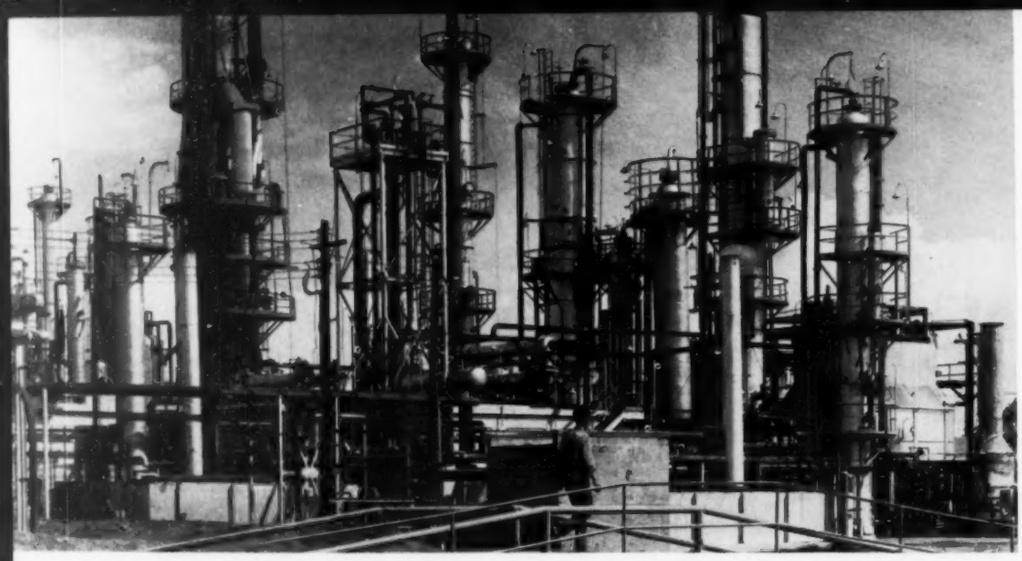
1956 saw the completion of Shell's $15 million expansion at the Montreal East refinery. This program, which was begun in 1955, has increased the refinery's daily crude intake to 60,000 bbl. The program included the expansion of topping and catalytic cracking facilities, the construction of platforming and hydrodesulfurization units, together with various treating and offsite facilities.

Currently, the construction of the new asphalt plant is under way. The plant, costing $1,000,000 will be completed in June this year, and will have the capacity to ship 600 tons per day of all grades of road asphalts. The asphalt plant feed stock will be prepared on existing distillation units at the refinery.

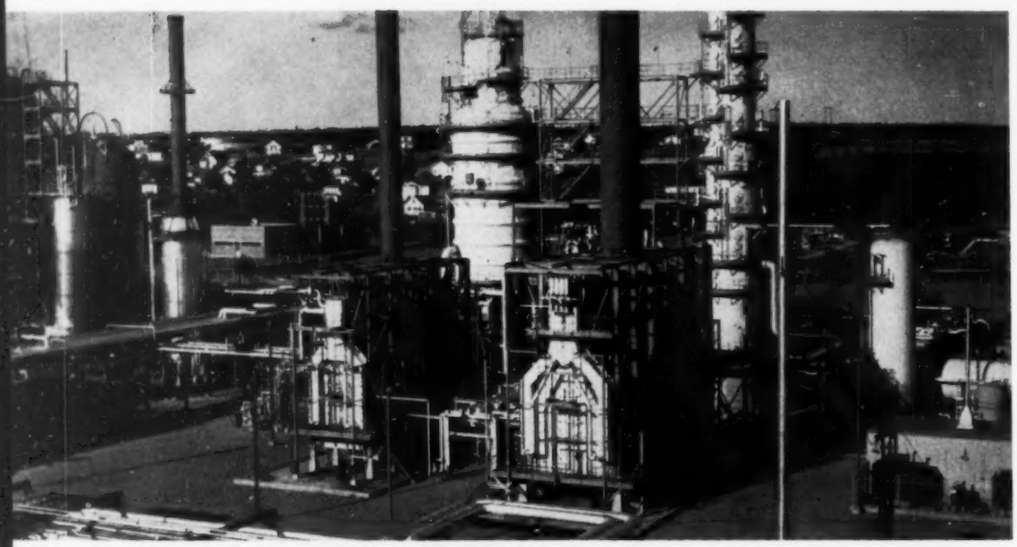
Extension of the Interprovincial pipeline to Toronto has stimulated plans for building new refineries and expansion of earlier plants in that area. Two large new refineries are being planned, and construction is expected to begin as soon as difficulties in connection with sites can be ironed out with zoning authorities.

Cities Service, which has had a substantial marketing operation in Canada for many years, now is planning to enter the manufacturing branch of the industry in the dominion. A prospective site has been obtained in the Toronto area, and plans are being drawn for a 20,000-bbl plant which is expected to cost about $22 million. It will process western crude delivered by the Interprovincial extension.

Concurrently, the company will undertake a multimillion-dollar expansion of its



General view of 6,500 b/d Royalite Hi-Way refinery at Saskatoon, Sask. (photo by courtesy of Royalite).



Atmospheric and vacuum distillation unit at the Halifax refinery of Imperial Oil Ltd. which, in 1956, was enlarged in capacity to 42,000 b/d from 18,000 b/d.

Burnaby, B.C., refinery of Standard Oil Co. of British Columbia: This 18,000-bbl refinery is equipped with catalytic cracking, reforming, and polymerization units, and produces asphalt.

marketing facilities in both Ontario and Quebec. New service stations and bulk plants are to be erected to provide outlets for the projected refinery.

In western Canada, Cities Service also is stepping up its exploration and drilling program.

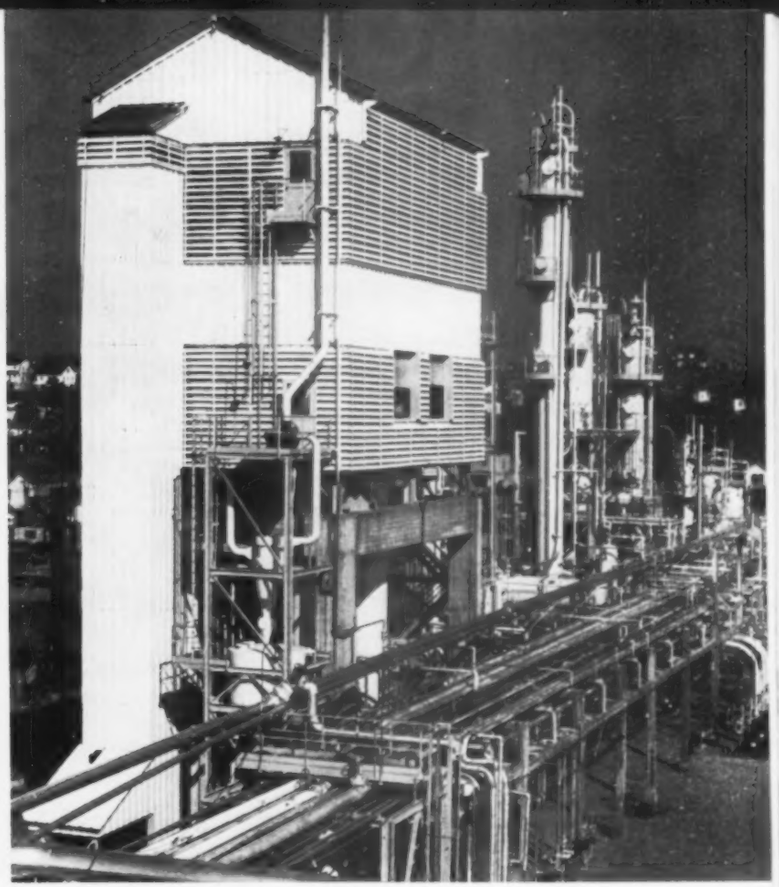
Shell Oil Co. also will build a major refinery in Ontario to take care of its business in that rapidly growing market. Two alternate sites have been placed under option pending negotiations with zoning officials. Thus far the company has not indicated how large a plant it expects to build, but most observers believe it will be a major installation. Shell now has a 20,000-bbl refinery in British Columbia, and the 60,000-bbl plant as Montreal previously mentioned. Products now are piped west from Montreal for the Ontario market. Construction of the Toronto refinery will permit the company to use western crude to supply its customers in Ontario.

There has been some speculation as to the future policy of McColl Frontenac, now that it has purchased the Regent refinery at Port Credit. Some observers believe that a logical step from McColl Frontenac will be to build a large new addition to Regent and to divert business to Regent instead of piping products west from Montreal. This would permit the company to increase the outlet for its substantial production in the West, and give it room to grow in Quebec, without starting another new building project at Montreal.

In terms of population growth, purchasing power, residential construction, development of secondary industries, and growth potential for people and industry, no part of Canada can equal southern Ontario. And, of all southern Ontario, the busiest section is the Lake Ontario area ringing Toronto and Hamilton. In many respects, the center of Canada's economic heartland lies here. Small wonder, then, that plans and work are well under way for stepping up the area's all-essential refinery facilities. Well in the vanguard of this Lake Ontario "heartland" expansion is British American Oil Co.'s refinery at Clarkson. The original refinery was completed in 1943, right in the middle of Canada's all-out World War II effort, when there was an urgent need for petroleum products for the armed services—including the far-reaching British Commonwealth Air Training Plan.

Clarkson refinery is situated on Lake Ontario, a few miles west of Toronto. During the winter, navigation on the Great Lakes is closed down for about five months. Therefore, to keep the refinery in operation at its present capacity of 21,500 b/sd through the winter, sufficient crude must be brought in by tanker when the lakes are open. This requires considerable tankage, and limits any crude expansion. However, in mid-1956, a throughput agreement between Interprovincial Pipe Line Co. and British American was arranged. This will result in the extension of the Interprovin-

A prefactionator tower, part of British American Oil Co.'s new 10,000-bbl catalytic reformer units at Clarkson, Ontario, is lifted into position.



Catalytic polymerization unit at Imperial Oil's Halifax refinery, built as part of a $30 million construction program completed in 1956.

cial Pipe Line from Sarnia to the Clarkson-Port Credit area by late 1957, directly linking the refinery with the oil fields of western Canada. This service will allow reduced inventories of crude oil and, coincidentally, a larger possible crude throughput.

Due to the increasing demand for all types of petroleum products in the Ontario market, it was necessary to undertake a major expansion of crude facilities at Clarkson. British American awarded a contract to Canadian Kellogg Co. Ltd. to engineer and build a topping and vacuum unit, which will more than double the existing crude capacity at Clarkson refinery. This project is scheduled for completion late in 1957. The new crude topping section is designed to process 40,000 b/sd of either 40 API Leduc or 27 API asphaltic crude to yield gases, gasoline, heavy naphtha, distillates, gas oil, and residuum. The new vacuum unit will be able to handle the residuum from either crude. Asphalt from the heavy crude residuum will be used in road building and industrial products.

The Leduc vacuum-tower bottoms will be further processed in a propane deasphalting unit to produce high-quality lube oils. Vacuum gas oils will be primarily cat-cracker feed stock. In anticipation of this expansion, the fluid cat-cracking unit, which began operation in 1954, was designed to handle the feed from a unit of this size. Also included in this project is chemical desalting of the crude, as well as copper-chloride gasoline-treating equipment for mercapten removal, and caustic-wash facilities for kerosine, stove oil, and diesel fuel.

In addition to the crude facilities, catalytic reforming and catalytic desulfurization units will be placed onstream at Clarkson in June of this year. Engineered and built by the Lummus Co. Canada Ltd., these units will enable British American to supply a greated quantity of high-quality motor gasoline to the central Ontario market. The catalytic desulfurization unit has been designed to handle 12,000 b/sd of a 400-F-end-point naphtha from western Canadian crudes before it enters the reformer. This unit circulates a hydrogen-rich gas from the reformer along with the naphtha to a single reactor. The cobalt-molybdate catalyst in the reactor promotes the reaction of the sulfur in the naphtha with the hydrogen to form H_2S, which is removed in the stripper. The desulfurized naphtha then proceeds to the reforming unit.

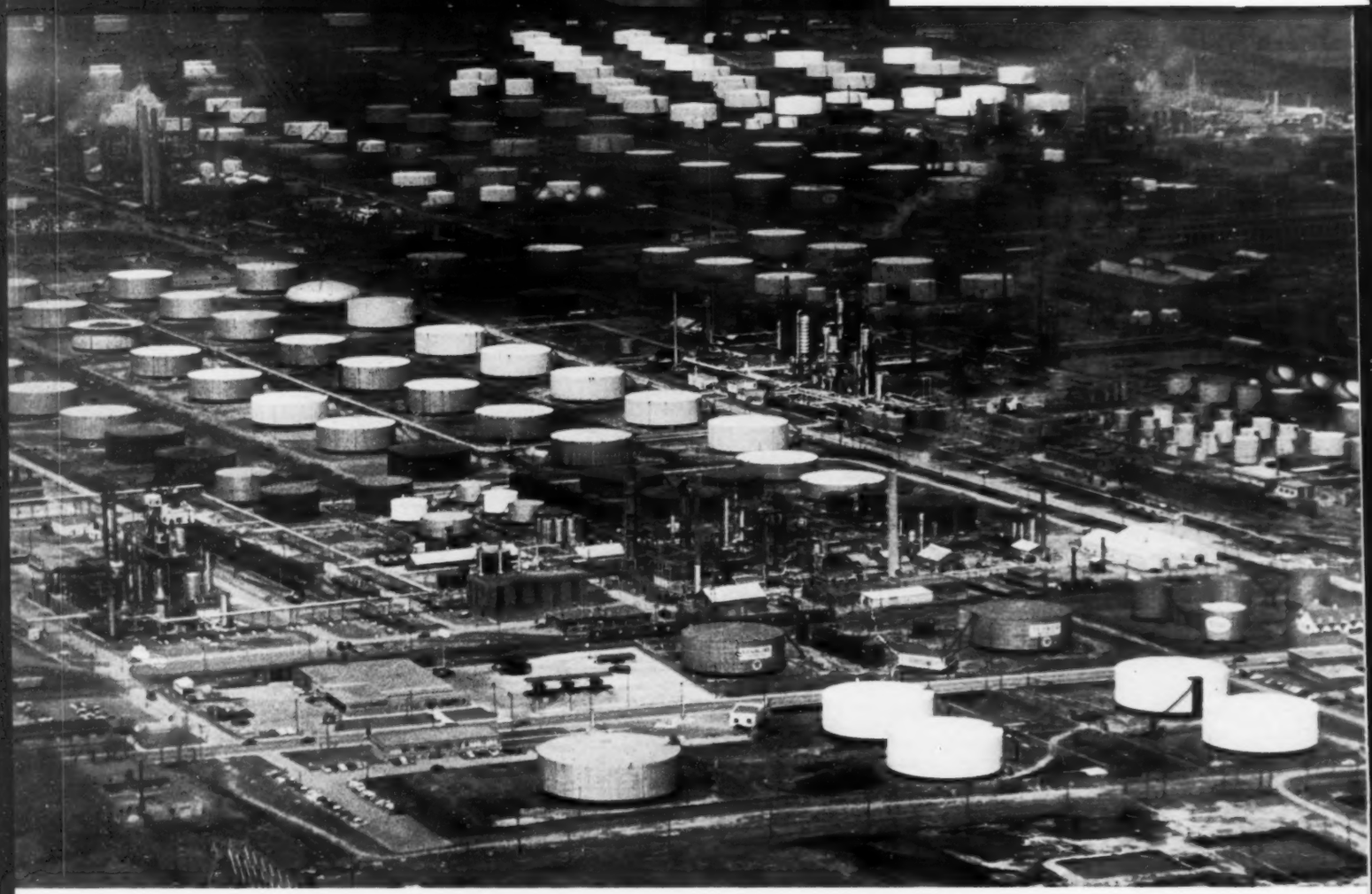
The Atlantic Catformer includes a prefractionator to prepare a 170- to 400-F-boiling-range product (depentanized) or, as an alternate, a 237- to 400-F-boiling-range (dehexanized) product as feed to the reactors. The depentanized feed, amounting to 10,250 b/sd, is reformed to yield reformate of 90 F-1 clear octane or higher. Provision has been made to split the reformate into a light (275-F-end-point) and heavy reformate. In this way, various blends with other light and heavy gasoline streams, including catalytically cracked gasolines, will enable maximum octane to be obtained on the finished motor gasoline. At the same time, better control of other properties, such as cleanliness, can be achieved.

To handle the increased demand for services to the new crude and reforming units, the following offsite facilities are being included in these projects, and are contracted to the Fluor Corp. of Canada Ltd. for completion late in 1957:

1. New cooling-water intake at the lake and distribution system.
2. New sewer system with separators for clean and for oily water handling: The separators are based on the latest industry design experience, and are arranged to take care of a large quantity of runoff water.
3. Expanded electrical distribution facilities.
4. Complete revamp of product handling and shipping facilities: This phase of the project includes segregation of the refinery into areas, such as pollution control, process, intermediate tankage, base-products tankage, product handling. This involves changes in service of certain tanks and additional tankage.

A very important installation for the future development of finished-product handling is that of one main refinery manifold. This will enable all refinery product movement to be handled from one control point, and lends itself to a future completely automated operation.

In-line blending facilities are also being installed, which will allow blending of all the components in the gasoline, including TEL, and other additives in the lines to the tank-car and tank-truck loading area,



McColl-Frontenac refinery: A general view of refining area at Montreal East.

to dock loading, or into the products pipeline.

Measures have also been taken to make each of the abovementioned areas independent as much as possible with respect to utilities, fire protection, and accessibility.

Canadian Oil Companies expanded its Sarnia refinery to 30,000 b/d during 1956, completing the job several months ahead of schedule and at a cost 20% below the estimate. The expanded refinery units have been operating at over 30,000 b/d since July 1956. Crude throughput for the year was up 23%, to about nine million barrels. The unit cost per barrel was down 8%, compared with 1955, due to the higher throughput and improved facilities. The advantages of higher capacity are shown in the number of employees, which is virtually the same as in 1953 although crude throughput has increased by about 50%.

Imperial Oil Ltd. enlarged and rebuilt part of its Sarnia refinery in 1955, bringing capacity of its Ontario unit to 78,000 b/d. A 13,500-bbl Powerformer for motor-fuel octane improvement was completed last September.

Currently, Imperial is completing a new $4.5 million wax plant at Sarnia, which will produce 35 million pounds per year. A new type of wax never before made in commercial quantities will be manufactured in addition to the usual commercial grades. Hydrofining techniques are to be employed to produce the new types of material.

To supplement its refining operations at Sarnia, Imperial has embarked on a large petrochemical construction program, which is described elsewhere in this issue. This involves a $3.8 million detergents plant, plus a $25 million ethylene-products plant.

Imperial's major project affecting crude capacity in 1956 was the $30 million Halifax rebuilding job. The project increased plant capacity to 42,000 b/d from 18,000 b/d. Old units which had been in service for many years were scrapped. A new 42,000 b/d atmospheric and vacuum crude unit was erected, as was a 13,500 b/d fluid cat cracker, a Powerformer, cat-poly and gas-recovery units, as well as extensive additions to storage, docks, and auxiliary facilities.

Aside from the crude expansion at Halifax, Imperial's major construction emphasis last year was in the building of catalytic reformers for motor-fuel improvement. In addition to the units at Halifax and Sarnia previously mentioned, Imperial built Powerformers at Montreal, Winnipeg, and Ioco (Vancouver).

Recently the company announced two crude-capacity-increase projects for its prairies' refineries. The Winnipeg refinery will be increased 2,500 b/d, to 17,500 b/d; and Calgary plant capacity will be doubled. Present capacity at that point is 9,200 b/d. The Calgary job will cost $17 million when completed.

At Wainright, Alberta, Wainwright Producers and Refiners Ltd. will increase its crude capacity 1,000 b/d in 1957, to 4,500 b/d. Other major construction planned for this year include cracking and reforming units and a cat-poly unit. Present plans are to build a cracker of 1,600 b/d capacity; 600 b/d reformer, and 50 b/d poly unit.

Consumers Co-operative Refineries Ltd. increased capacity of its Regina (Saskatchewan) plant a third last year—to 16,000 b/d from 12,000 b/d. The refining now has a 6,500 b/d vacuum still, 5,000 b/d UOP fluid cat cracker, 3,000 b/d vis-breaker, and 500 b/d poly unit. LPGas produced, as well as conventional liquid products.

British American made no additions to its western crude still capacity in 1956, but construction was begun at Edmonton of a cat reformer with a feed-preparation unit. Scheduled for completion early in 1958, these units are being engineered and built by the Lummus Co. Canada Ltd. The feed-preparation unit, utilizing cobalt-molybdate catalyst in a single reactor, has been sized to desulfurize 6,300 b/sd of a 400-F-end-point naphtha from Alberta crudes. This will remove excess sulfur, nitrogen, and metals wich poison the platinum reforming catalyst. It is very probable that, in the not-too-distant future, the thermal and coker gasolines must be upgraded. Consequently, the cobalt-molybdate unit has been designed to treat these olefin-containing gasolines, in addition to the other features. A prefractionation section to prepare a charge stock for the catalytic reforming reactors is part of the installation. Extreme flexibility has been provided to allow hy-

drogen treatment of various feed stocks, including a heart-cut, before or after prefractionation.

The reforming unit is of the type licensed by The Atlantic Refining Co. and usually described as a Catformer. It has been designed to handle 5,400 b/sd of a depentanized 400-F-end-point naphtha, with a yield of 83% debutanized reformate of 90 F-1 octane quality. A higher-octane product can, of course, be obtained at a lower yield. Other charging stocks at various feed rates can also be handled in this installation, under a variety of conditions.

Royalite Oil Co. Ltd. is carrying out construction projects at three of its four refineries in the West, although most of the work in hand is designed for product improvement rather than enlargement of crude charging capacity. Royalite has a capacity of 17,500 b/d at its four refineries, three of which are in Saskatchewan and one in British Columbia.

At the Kamloops, B.C., refinery a 1,000 b/sd UOP Platformer is being built in connection with a 1,500 b/sd Unifiner. Both units will go on stream next November. Kamloops now has a capacity of 5,000 b/d, and is equipped with a 2,800-bbl vacuum unit, a 1,400 b/d UOP fluid cat cracker, and a 500 b/d cat-poly unit.

An oxidized asphalt plant capable of processing 250 b/sd of heavy oil was completed at Royalite's Coleville (Saskatchewan) refinery in March of this year, and a month later a 5,000 b/d Petreco desalter was commissioned. This refinery has a 5,000 b/d capacity and a 3,800 b/d vacuum unit. At Saskatoon, crude capacity is being increased 1,500 b/d, and, by next August, crude capacity will be up to 8,000 b/d. The plant has a 3,800 b/d vacuum still and visbreaker, a 2,600 b/d fluid cat cracker, 1,600 b/d desulfurizer, and 700 b/d cat-poly unit. No work is in progress at the 1,000 b/d Prince Albert plant.

British American Oil has just announced plans for construction of a new multi-million-dollar refinery at Port Moody, B.C., near Vancouver. With a capacity of 20,000 b/d, the refinery will serve the growing Vancouver and West Coast markets with a complete range of high-quality oil products. Scheduled for completion late in 1958, the refinery will be located on a 400-acre site adjacent to BA's Burnaby marketing depot. It will be completely integrated and, in addition to topping and vacuum facilities, the main installations will include catalytic cracking and reforming and alkylation units for the production of high-octane gasolines.

Contract for building the refinery has been awarded to Canadian Kellogg Co. Ltd., and preliminary construction is under way. When completed, the refinery will employ 175 people.

Excelsior Refineries Ltd., of Edmonton, plans to construct an oil refinery at The Pas as the first in northern Manitoba where mineral and power developments are opening an expanding market for petroleum products. Announcement was made in Winnipeg, Manitoba, that the refinery will have an initial minimum capacity of 2,000 b/d of crude. The plant will be engineered so that its capacity quickly can be doubled if necessary. Mining companies have indicated that some $300 millions will be spent in Manitoba during the next three or four years.

In noting the mineral and power developments in northern Manitoba, Excelsior stated that "a large and expanding market is opening up for petroleum products in the northern Manitoba and northern Saskatchewan areas tributary to The Pas." "Having sold our X-L refinery at Lawson Creek, we can expect to look more and more at the markets of these areas to the northeast," the firm stated.

Excelsior has purchased 170 acres of land at The Pas. Construction of the refinery is expected to start this year, although no definite date has been announced. Cost has not yet been estimated.

Regina, Sask., refinery of Consumers' Co-operative Refineries Ltd., which recently has been enlarged to 16,000 b/d from 12,000 b/d: The plant is equipped with vis-breaking, catalytic cracking, and poly units.

Oil Pipeline Traffic Rises

Exports of larger volumes of Canadian crude to the Pacific Northwest, to Minnesota and Michigan, aid pipelines in 22.6% gain in 1956 business.

DELIVERIES of major crude-oil pipelines in Canada increased 22.6% in 1956 to 275 million barrels. Deliveries in the previous year totaled 224 million barrels. Barrel-miles rose 32.6% to 111 billion, creating a similar rate of rise in pipeline revenue.

Indications are that 1957 pipeline business will continue to climb as a result of increased deliveries to refineries in the United States and expansion of still capacity in Ontario.

Oil pipeline construction activity will be greater than in recent years as both Trans Mountain Oil Pipe Line Co. and Interprovincial Pipe Line Co. undertake major construction projects.

Interprovincial this year will complete looping its lines between Edmonton and Lake Superior, with the result that it will have a complete dual system between these two points. It will have reached about ultimate capacity for the system west of that point, and any further big increase in demand will force the company to start on an entirely new line.

East of Superior, Interprovincial has plenty of ultimate capacity into Sarnia for the immediate future.

A major undertaking by Interprovincial this year is the extension of its line from Sarnia to the Toronto area. This will require the laying of 155 miles of 20-in. pipe. The extension will serve Regent Refining's 20,000-bbl plant at Port Credit and the 40,000-bbl refinery of British American Oil Co. at Clarkson. The initial outlet of about 60,000 b/d will be increased by another 40,000 b/d or more within the next two years or so, when Cities Service and Shell build big new Toronto plants.

Looping of western segments of the line in 1957 involve laying 110 miles of 26-in. pipe. Between Regina and Cromer 32 miles of loop will be laid which, with the addition of more pumping power, will increase capacity of that segment from 215,000 b/d to 330,000 b/d. At the Regina station, two 2,000-hp pumps are to be installed, while one extra pumping unit will be added to other stations. Between Edmonton and Regina four portable Triplex pumps were installed in the fourth quarter of 1956 to bring capacity up from 217,000 b/d to 221,500 b/d.

Between Cromer and Gretna 26,000 b/d of added capacity will be obtained this year by installing four 2,000-hp pumps. Two will be at the Cromer station and two at Glenboro. Capacity of this segment of the line will rise to 290,000 b/d.

Completion of the last link in the looping program will involve laying 78 miles of 26-in. between Gretna and Superior. This will be accompanied by the addition of a new pumping unit at Viking and one at Clearbrook. Capacity of the line from Gretna to Clearbrook will be increased 47,000 b/d, to 275,000 b/d; while from Clearbrook to Superior the increase will be 85,000 b/d, to 260,000 b/d.

Because of the new Michigan demand for crude, plus the enlarged deliveries in prospect in Ontario, Interprovincial will build a new 4,400-hp. pumping station at Indian River, Mich., which will increase delivery capacity from Superior to Sarnia to 242,000 b/d. Last year the capacity was 147,000 b/d. Some work is to be done now on a proposed new station at Gold City, so that capacity of this segment of the line can be increased still further on short notice.

Interprovincial delivered 1,600,000 bbl of crude to Michigan refiners in 1956, and expects this to rise to nearly three million barrels in 1957.

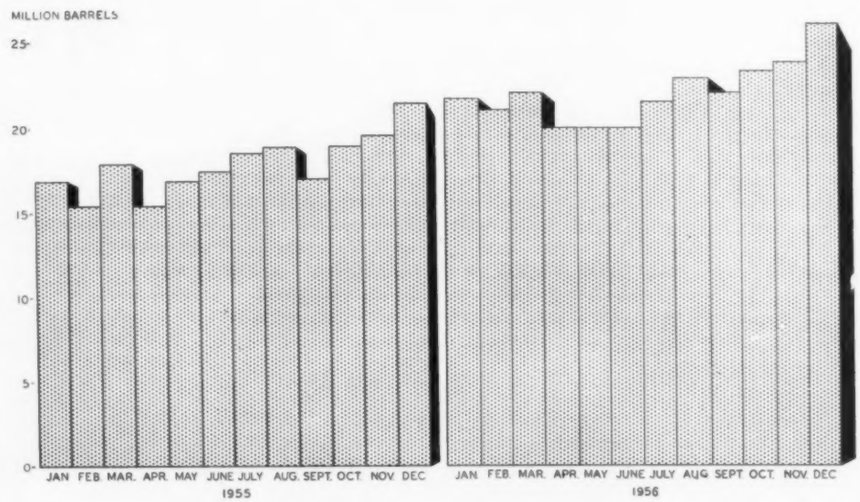
At Sarnia, Interprovincial picked up a new customer in April, when Sun Oil Co. began taking 5,000 b/d of western Canadian crude. Sun has been processing USA crude heretofore. Of the other local refineries, Imperial Oil Ltd. takes 57,000 b/d and Canadian Oil Companies 28,000 b/d.

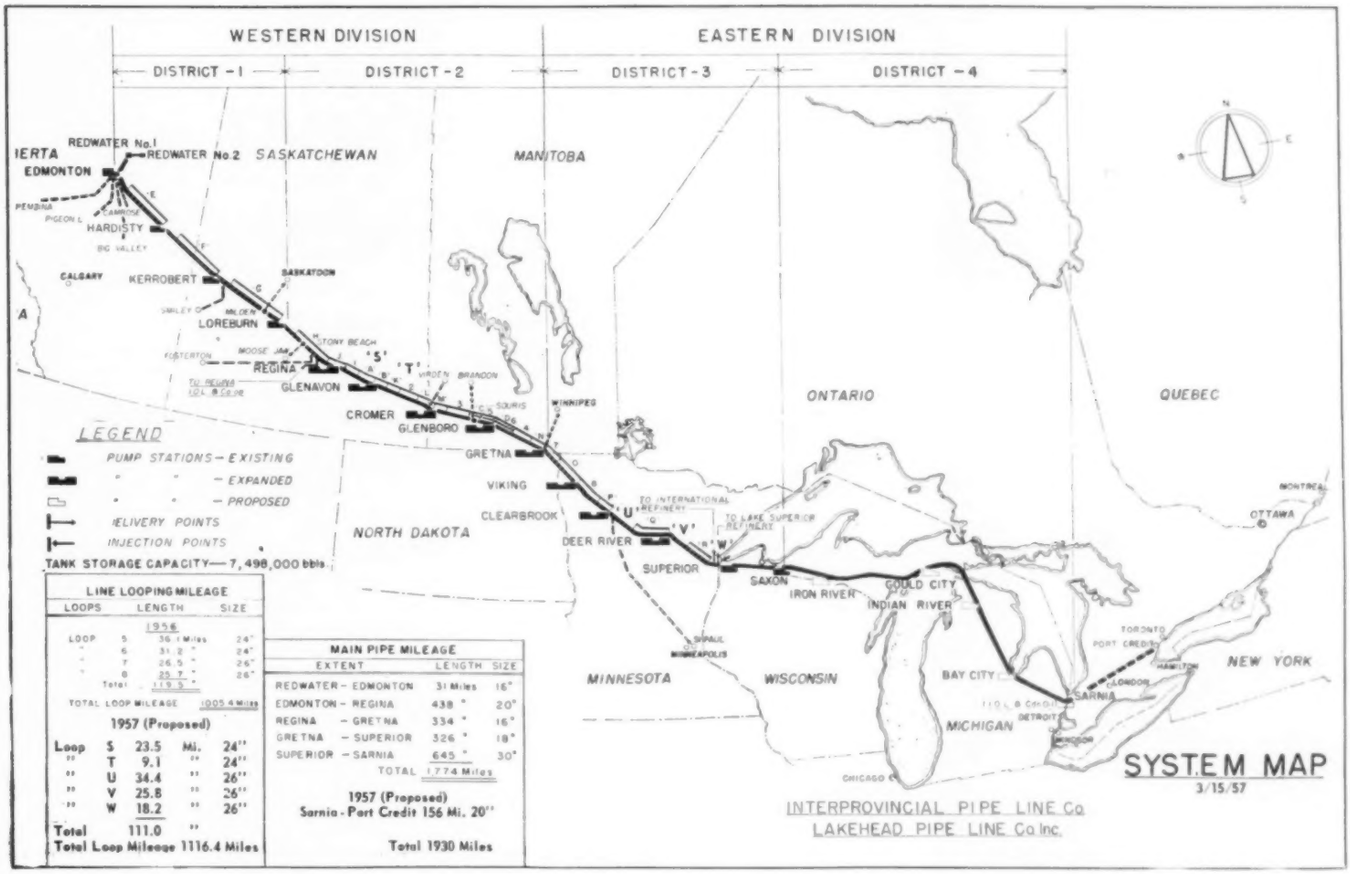
For its new extension from Sarnia to Toronto, Interprovincial will start with one pump station which will provide an initial capacity of 90,000 b/d. This new station, as well as a number of others being built by Interprovincial, will utilize electric motors as prime movers.

Interprovincial delivered 97,116,072 bbl of oil to its customers in 1956, compared with 80,701,123 bbl in 1955, an increase of 20.3%. Projects scheduled for 1957 construction total $26 million, all available from the company's cash resources. Net income during 1956 amounted to $9.7 million, equivalent to $1.92 per share. The company's increased activity is reflected in operating revenues, up 23% in 1956 to $41.8 million, while expenses were up only 15%.

The 718-mile Trans Mountain line has undergone a steady increase in capacity. During 1956 work commenced on two permanent pumping stations at Gainford and Jasper to bring the capacity of the system to 200,000 b/d. These were scheduled for completion by May 1957, but throughput requirements necessitated earlier increases. Accordingly, temporary units were installed at each of these sites which raised the capacity to 185,000 b/d.

An electrically powered pumping station was built at Laurel, Wash., and completed in December 1956. This station will enable the 20-in. Washington section of the system to operate up to 200,000 b/d.





A major development during the year was the movement of 53 tank loads of Canadian crude offshore from Trans Mountain's Westridge marine terminal. The first movement occurred January 1, 1956. Work has commenced, for completion by August of this year, of a program to expand further the system's capacity to 240,000 b/d. This program includes the construction of three temporary stations at Niton, Alberta; and at Albreda and Kingsvale, B.C., two 50-mile loops, one east of Kamloops and the other west of Edson, together with a permanent pump station and tank farm at the junction of the spur line to Washington at Sumas, B.C.

During the first part of 1957 the increased capacity of the line was evident from throughput figures. They rose from actual deliveries during February of 177,544 b/d to about 190,000 b/d during March, and are estimated to average 191,000 b/d during April.

The company and its subsidiaries had a net profit in 1956 of $6,991,000, or $4.65 a share. Gross revenues totaled $22,964,000, from which was deducted operating expenses of $3,337,000, depreciation $3,444,000, interest $2,897,000, and income taxes of $6,295,000.

Pembina Pipe Line Co. completed its main pumping station in 1956, and continued to expand its gathering system throughout the Pembina field. The line extends some 70 miles from the field to Edmonton, where deliveries can be made to local refineries or to Interprovincial or Trans Mountain. In its second year of operation the line delivered 33,673,095 bbl of crude, compared with 14,381,796 bbl in 1955, an increase of 133%.

An important addition to the Canadian pipeline system in 1956 was the 109-mile Westspur Pipe Line Co.'s 12-in. line from the rapidly expanding producing area in southeastern Saskatchewan to the Interprovincial pumping station at Cromer, Man. This new $6.5 million system was built by a group of 15 oil companies to serve such fields as Midale, Alida, Frobisher, Hastings, and Nottingham.

History has repeated itself in the case of Westspur. Like many lines in the past, it was scarcely laid before it was found not to have enough capacity to take care of the traffic available to it. Very rapid development and high success ratio of wells drilled in southeastern Saskatchewan have brought production from 12,000 b/d at the beginning of 1956 to four times that figure currently. Much of the current output is being trucked to pipeline pumping stations.

Westspur will lay 75 miles of 16-in. loop this year and build branch and feeder lines to new pools. One such is the Steelman field. Capacity of the line currently is about 40,000 b/d, and this may be increased to about 125,000 b/d.

Also delivering to Interprovincial at Cromer is the Trans-Prairie Pipelines Ltd. which has 67 miles of 6-in. extending to the Daly, Virden-Roselea, North Virden, and Woodnorth fields in Manitoba. Trans-Prairie gathers most of Manitoba's oil. Recently it extended its activities into Saskatec, where it is gathering crude in the Weyburn and Halbrite fields for delivery to Westpur at its Midale terminal.

Largest feeder system in the West is the Imperial Oil Ltd. gathering complex, which handled 54 million barrels of oil in 1956 compared with 55 million barrels in 1955.

The Sturgeon lake area is served by a 106-mile line connecting with Trans Mountain at Edson, Alta.

Prospective growth in the production of LPGas in western Canada as a byproduct of the "big-inch" gas lines has activated an earlier proposal to build a line to deliver these light products, as well as heavier refined oils, from Alberta to the Great Lakes. Canadian Hydrocarbons Ltd. has been granted a charter incorporating Hydrocarbons Pipelines Ltd. for this purpose. The line would gather propane, butane, gasoline, and kerosine in Alberta, and from other sources, for delivery to intermediate points and to Fort William for tanker shipment to eastern Canada. Plans would be to provide underground storage at various points to provide seasonal flexibility to its operations.

END

Drilling rig readied for skidding to a new location in the Coleville field. All photographs with this article are published through the courtesy of Royalite Oil Co.

SOUND ECONOMICS IN SASKATCHEWAN

By Leslie O. Rowland
Editor, Oil in Canada

A high discovery rate in Saskatchewan—backed by shallow, prolific production and an accessible territory—is the solid basis for Saskatchewan's oil prosperity. Increases in the province's production are squeezing Alberta's crude out of the Interprovincial line to the east, and marketing prospects for Saskatchewan crude are better than those of any other province.

SINCE the late fall of 1954, the 5,000 square miles of oil-search territory in the southeastern corner of Saskatchewan has commanded a phenomenal interest on the part of many major operators and small independents. Result is that it has become the hottest wildcatting region and the scene of the most rapid growth in development drilling ever experienced in western Canada. The extreme attractiveness of this concentrated area has brought active drilling rigs up to a high of 90 within the past few months—one-third of all the rigs in western Canada. It has contributed several million dollars to the Saskatchewan provincial treasury in cash bonus bids on Crown reserve sale leases. It has brought expenditures of new capital up to an estimated current rate of more than half a million dollars per day, while development well completions in the normally slack month of January numbered 62 out of 66 for the whole province, and set a starting pace for 1957 of more than double the rate for January 1956.

In 1956 there were 594 new oil-well completions in the dozen or more fields and pools in the southeast. This year, it has been forecast by industry statisticians and by Hon. J. H. Brockelbank, provincial Minister of Mineral Resources, that there should be at least 800 new oil wells drilled in the region—an increase of more than one-third over 1956.

There are several factors which have contributed to this remarkable operation in southeastern Saskatchewan, in the face of a steadily increasing proration of crude-oil production in Alberta and the beginning of a downward trend in producibility of the nearby Manitoba fields. The composite of these factors is an indication that southeastern Saskatchewan offers the new entrant into the search for oil in western Canada an unprecedented wildcat success ratio established over the past 2½ years—plus reasonably good terrain—and, therefore, relatively low development costs; a year-round drilling program; and, perhaps, the most significant of all, adequate pipeline transportation facilities which communicate directly with a tremendous and fast-growing crude-oil market comprising the entire province of Ontario and a large part of the states of Minnesota, Wisconsin, and Michigan.

The pipeline system which serves the area was originated by Westspur Pipe Line Co. (now a subsidiary of Producers Pipelines Ltd.), owned by 15 producing companies, in the summer of 1956, and plans have already been completed to more than double the original capacity of the line. No proration of crude-oil production has yet been necessary, and the evidence of the effect of this leading factor on the pace of development has been the steady growth of production in the region from a modest 12,000 b/d in January 1956, to a calculated 50,000 b/d in March 1957.

In examining the various factors which have made southeastern Saskatchewan so phenomenally attractive, the fundamental consideration is the exceptional productivity of the region. Hardly less important, however, is the moderately shallow depth of production. The range is from an average of 3,700 ft in the Alida field, near the east

edge of the region, to 5,000 ft in the Midale field, towards the western end of the lush producing area. The median depth of the bulk of wells is between 4,500 ft and 4,800 ft. Although footage rates are high enough to be very satisfactory to drilling contractors, costs are more moderate than they would be for most Alberta wells of a similar depth.

Probably never, in such a concentrated area, has there been such an astonishing discovery ratio in wildcat drilling as has occurred since 1954. Out of 53 wildcats drilled in 1955, 19 became oil discoveries. Out of 116 in 1956, 41 found oil—establishing a ratio of better than one in three for two years in succession. One of the favorable elements in this area is the presence of a single formation, the Mississippian limestone, which appears persistently oil-bearing throughout and has two well-developed producing members, the Charles and the Mission Canyon, in that order of descent. Oddly enough, as the formation dips to the west and south, the higher Charles member becomes the more productive, so that the depth to pay zone does not increase appreciably from the fields in the middle of the region to those on the western side.

The stratigraphy of the region has been dealt with admirably by Dr. John G. C. M. Fuller, principal geologist for the provincial Department of Mineral Resources. He explains that post-Cretaceous tectonic ripples on the surface, superimposed on the ancient topography of the region, form long, low swells, elongated in northeast-southwest trends. Seismic and well-log records show that these warps have their counterparts in the Devonian rocks below and the Jurassic above. Where their crests coincide with topographic hills, the contour closures on the highs can attain 75 ft. The type of oil traps, found prolifically in the southeastern region, occurs when porous beds, slanting up from the south with the regional dip and abutting against the impermeable erosion surface, coincide with one of these closed tectonic highs.

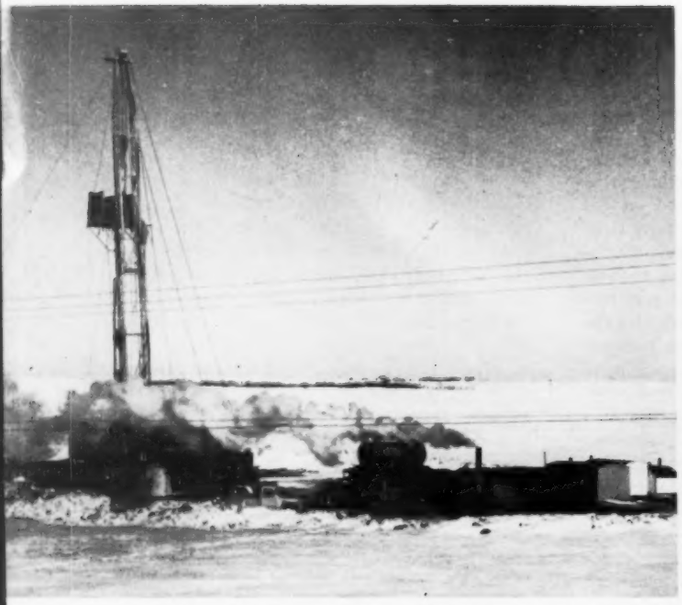
Thus the Alida-Nottingham fields are elongated in a northeast-southwest trend, and limited on their northeastern edges by erosional loss of the reservoir beds. On the long flanks, they are bounded by structural and topographic slopes of the cap rock which either cut off the reservoir beds or bring them below the water table. The southwesterly limits of the fields are determined less definitely by flattening of the structures, and are not fully explored—especially since the limits in this direction are uncertain due to the slope of the water tables almost in conformity with the erosion surface.

The fields farther west are mainly stratigraphic traps without the prominent slanting shape of the more easterly pools—although there are indications of a considerable number of the Alida-Nottingham type pools almost up to the eastern edge of the Frobisher field. The westerly fields, starting with Frobisher, are composed of traps in which both the reservoirs and the cap rocks were units of the original depositional sequence. The main pools lie at structurally high downdip locations, where porous oölitic limestones have been bent slightly into shallow domes, and closures reach a maximum of 50 ft. The elongation is not so pronounced.

The very broad area of deposition, and the frequency of occurrence of the parallel oil pools, are both excellent primary factors making the southeast highly economic for oil search. The discovery ratio which has been so persistent for more than two years is continuing to be exceptionally good.

Development of discovered pools shows a tendency for the pay-zone thickness to be very good and producibility satisfactory. Here are the average pay-zone thickness figures for the principal fields: Nottingham, 60 ft; Hastings, 39 ft; Steelman, 33 ft; Kings-

Mud engineer supervises mud conditioning at Saskatchewan well.



Winter drilling on the plains of Saskatchewan requires protection for personnel.

Sand "frac" stimulation of wells in the Coleville field aid production.

ford, 53 ft; Midale, 48 ft; Frobisher, 31 ft; Carnduff, 30 ft. Official MPR rates, set in November 1956, include: Nottingham, 160 b/d; Hastings, 58 b/d; Steelman, 80 b/d; Kingsford, 88 b/d; Midale, 75 b/d; Frobisher, 50 b/d; Carnduff, 53 b/d.

The cost of drilling is pinpointed by the allowances provided in the regulations concerning percentage royalty bids for Crown reserve sales. For the Nottingham, Alida, and Hastings fields, average depth is 3,600 ft to 3,900 ft; $55,000 per well is allowed. For Steelman, Kingsford, Glen Ewen, Frobisher, and Carnduff—with depths averaging from 4,300 ft to 4,900 ft—the allowance is $60,000. In the Midale field, which averages 5,000 ft in depth but has special problems of drilling, $65,000 per well is allowed.

The Westspur Pipe Line Co.'s 109-mile 12-in. main crude-oil pipeline serves most of the region—from Midale, where its first main input terminal is situated, across the Manitoba border to its terminus at Cromer pumping station on the Interprovincial Pipe Line Co. line. The Weyburn and Halbrite fields are now tied in through a small gathering system operated by Trans-Prairie Pipe Lines Ltd. The 1957 construction program, as projected, includes 75 miles of 16-in. main-line loop to provide capacity for increased production from the Steelman field and new fields and pools east of it, and several branch and feeder lines to pick up production from some of these pools. Capacity at the end of February was more than 42,000 b/d—slightly more than the current rate of traffic; and the new construction program is expected to boost potential throughput to more than 100,000 b/d, and probably about 125,000 b/d.

The market range made possible by the connection to Interprovincial includes Ontario, with refining capacity of nearly 200,000 b/d, to be operating by 1958; and Minnesota-Wisconsin-Michigan, where possible use of light crude may reach 25,000 b/d this year, and medium-gravity crude from the southeast is already filling a demand for some 10,000 b/d. The southeastern Saskatchewan fields are capturing these markets as fast as production can be turned into the pipeline, and there appears no immediate limit on the extent to which Saskatchewan crude can back out the Alberta oil which has been their traditional supply source.

The acquisition cost of leases is largely indicated by the results of recent Crown reserve sales, although wildcat acreage in almost all cases must be obtained by farmout from present holders. The provincial government does not put up most wildcat acreage in the southeast, preferring to hold all Crown parcels until discoveries have been made on freehold rights in proximity to them. This policy has resulted in securing maximum value on most of the Crown sales.

Typical recent prices have been from $203,000 to $362,007 for quarter-section parcels in the Kingsford and Steelman oil fields—containing two well sites under the mandatory 80-acre spacing. Earlier leases were acquired for lower cost per acre—a fair average of 1956 cash bonus bid prices being $1,000 to $1,200 per acre, compared to a range from $1,250 to $2,400 per acre in the first sale of 1957.

Wellhead prices for comparable gravity of crude run about 10 cents over Alberta prices. The complete posted schedule, announced by Imperial Oil Ltd. in January, for the major fields, includes: Frobisher, $2.805; Alida, $2.795; Nottingham, $2.77; Steelman, $2.695; Kingsford, $2.685.

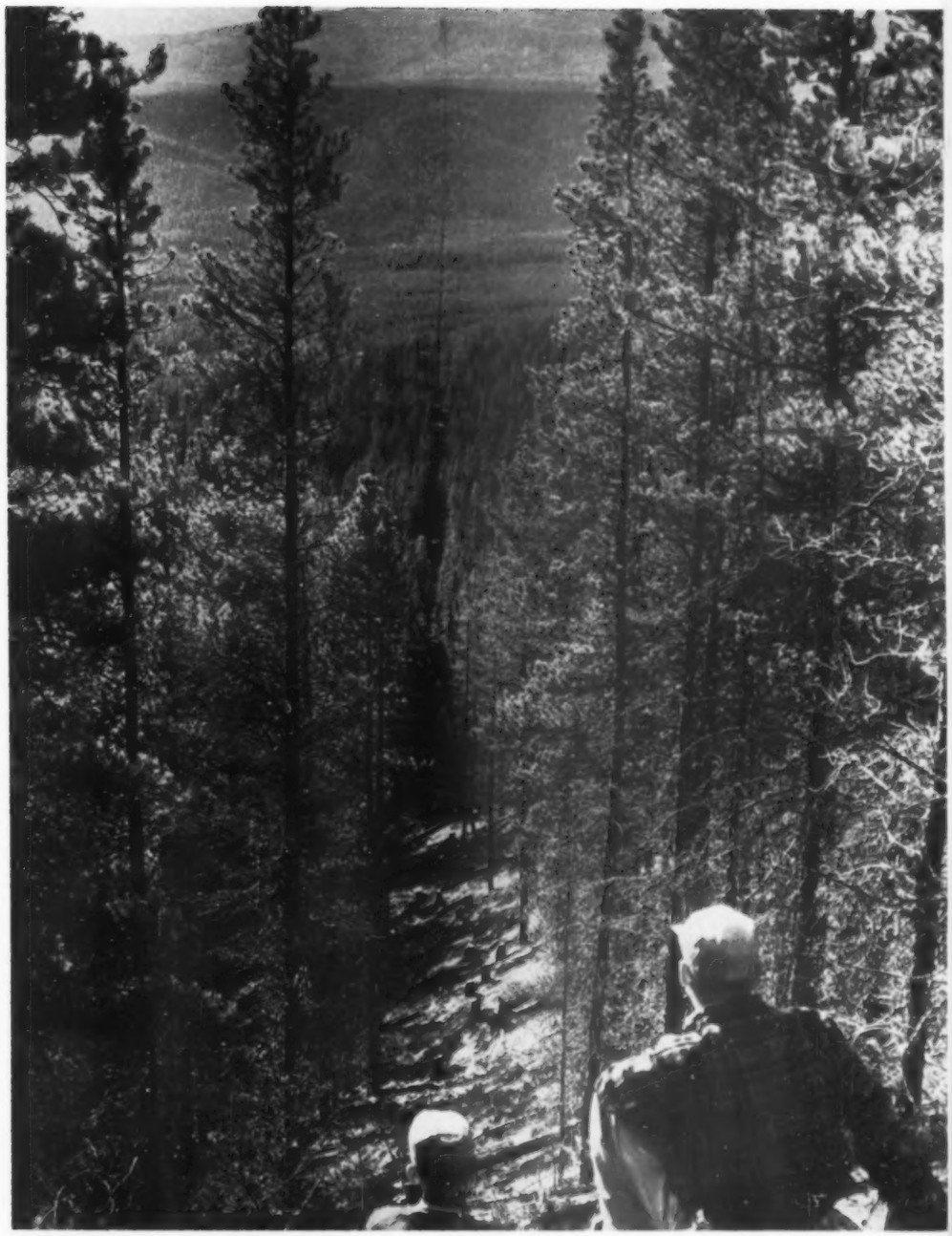
Saskatchewan crude oil is competitive with any United States supply sources in the northern states in which it is finding its current export markets. It is also competitive with crude from Alberta which traditionally has supplied these markets. There is every indication, as a matter of company policies, that oil from southeastern Saskatchewan will continue to fill an increasing share of the light crude markets both in eastern Canada and in the northern states. The long-range prospect is for a faster rate of growth in this direction than can be foreseen for Alberta oil in a westerly direction. Thus the ratio of producibility to production should continue to be less pronounced in Saskatchewan than in Alberta, where MER is running currently to about double allowable production.

The payout rate for producers in the southeast, as determined by the relatively high proportion of MER which can be produced, is likely to be shorter than in comparable Alberta fields. Probably the best comparisons are with Pembina, whose current per-well allowable is only 73 b/d on 80-acre spacing, and Redwater, one of the oldest fields of the modern era (discovered in 1948), whose wells currently are allowed 78 b/d. The drilling depth in the Pembina field averages 5,000 ft in the central sector, and increases to nearly 6,000 ft in the area which is now under the early stages of development farther west.

The ultimate market for southeastern Saskatchewan light crude can be forecast as upwards of 300,000 b/d by 1960, if enough more fields are discovered to raise producibility to a level which can support it. In any case, for quite a long time to come, the problems in Saskatchewan will be more concerned with producing enough oil for the potential market than in prorating producibility to a tightening market which exists in Alberta operations at present. END

EXPLORATORY DEVELOPMENTS IN WESTERN CANADA 1956

By Floyd K. Beach



Royalite geologists look over 25-mile hand-hewn cut line during seismic survey in the Alberta foothills.

Exploratory and development drilling in Western Canada continued to increase in 1956. About half Alberta's development work was in Pembina field, which should be nearly drilled up this year. In all, over 600 dry holes were drilled which supplied significant geological information.

More wells were drilled in western Canada in 1956 than during the previous year, although the increase was not so great as during several previous years. Total wells were 3,282 (2,935 in 1955); average depth was 4,700 ft (4,350 ft in 1955). In addition, a number of wells were drilled in Saskatchewan to explore for potash and, in so doing, they penetrated all horizons which elsewhere yield oil or gas; but figures on potash exploration have been withheld by the government. They do not greatly affect the whole situation in any event, although 1955 figures included 15 wells for potash exploration.

In the aggregate, both exploratory and development drilling increased. Manitoba showed a decrease in both categories, but the other provinces more than made up for the decrease in Manitoba. That province has a very limited area where oil may be expected.

Of the 1,856 development wells in Alberta, 857 were drilled in the Pembina field, com-

Special vehicles continue to be designed for reconnaissance in the difficult operating terrain of the muskeg. This Mercedes Benz unit, which has been undergoing tests by Shell automotive engineers, is the "Unimog S," shown here transporting a Bombardier 15 tracked vehicle. It is powered by an 85-hp diesel, giving it a speed range between 0.9 mph and 59 mph. Three important features of the unit are: 1, front wheel drive can be engaged or disengaged without operation of the clutch; 2, both front and rear differentials lock; 3, high clearance makes the vehicle adaptable to uneven terrain.

using the definitions of the American Assn. of Petroleum Geologists committee for statistics on exploratory drilling. Rated as successful were 106—with 52 oil discoveries, 52 gas discoveries, and 2 condensate, for an 18% degree of success as compared with 23% in 1955. To a very high extent, wildcats were located on technical grounds, with both geology and geophysics generally used.

Granite Wash: Early in 1956 a discovery of a prolific oil producer in the Granite Wash in northwest Alberta (Union Oil of California Red Earth, 12 of 17, 87-8 W.5) sparked a land play of big proportions. Reservations were taken out that plastered practically all Crown land in the northern part of Alberta and even extending into Saskatchewan. Exploratory drilling consequent to the land play has been spread rather widely. Some further discoveries of oil in the Granite Wash have followed, but even development follow-ups have been erratic. In the township where the first discovery was made, two step-outs of a mile have been successful, but early follow-ups of five miles to the north and three miles to the east failed. Some other similar teasers in the Granite Wash suggest that its oil occurrences are likely to be in relatively small pools. Of course, there is always the hope that some locality may afford conditions favorable to a greater size. Considering that the presence of a bed of clastics on the erosional surface of Precambrian igneous rocks thick enough to provide good reservoir characteristics is likely to be limited in area, it is probable that some searching will be needed. Possibly the seismograph will help.

Other Alberta Discoveries: Oil was found in the Viking sand near Bentley, and by the end of the year a field was fairly well developed with 40 oil wells and 4 dry holes. The trend is roughly along that of the

pared with 626 in 1955. That immense field is not yet fully developed, although it may be pretty well developed by the end of 1957.

In Saskatchewan development drilling was concentrated in the southeast part of the province, where oil has been found in two belts extending in a generally east-west trend and roughly parallel to each other. Both belts have oil in the Mississippian close to the erosional subcrop of Paleozoic.

In British Columbia the development drilling has been largely in the Fort St. John field, to supply gas to the Westcoast Transmission line, but with some oil development drilling in the Boundary Lake field.

Northwest Territories development drilling was confined to four wells in Norman wells field, three of which were directionally drilled to bottom under the Mackenzie River.

Of the 899 exploratory wells in the western provinces, 586 were new-field wildcats,

A shothole blast in the forests of northern Alberta: The seismic party travels in tracked vehicles—one of which is seen in the background. (Photo courtesy of Shell Oil Co.).

Joffre field, with a gap of 6 or 8 miles still intervening. Still farther west and a little north on the same trend, Gilby has oil from the Viking sand.

The Cardium sand has chalked up oil discoveries in scattered spots, ranging from a well only about 18 miles north of Calgary (Shell Crossfield 13 of 2, 18-2 W.5) to a well between two large tributaries of Peace River (Baysel et al., 16 of 4, 64-6 W.6), and this suggests that there are still further occurrences of Cardium sand which may be productive. One such occurrence is in the Keystone area, some 12 miles east of the present eastern limit of Pembina field, where Cities Service has a number of oil producers. An eastward extension far enough away to rate as a wildcat has also found oil—Cree Oils being the operator.

High River: A Texaco well in 1 of 25, 18-30 W.4, found oil in the uppermost Devonian, rating initial production of 326 b/d on restricted choke. Other discoveries in this horizon farther north have been natural gas, with up to 50% hydrogen sulfide. A followup well is drilling to evaluate the discovery. It is about three-quarters of a mile south and a little east.

Windfall: A gas discovery late in 1955 in Leduc formation (Devonian reef) has now had two long step-outs, and appears to mark a good-sized gas field in Townships 59 and 60, Ranges 15 and 16, West 5th. Early 1957 drilling suggests there may be oil in shallower horizons in part of this area.

South Sturgeon Lake: With its principal oil horizon in Leduc formation, it added Triassic pay in 1955 with some development drilling in 1956, and early in 1956 oil pay from the Mississippian was added when a well drilled to the reef backed up and perforated the Mississippian. Drilling of this well actually finished late in 1955. Most wells completed in the reef are around 8,500 ft deep; so development is relatively slow.

Normandville: Imperial in 1949 scored an oil discovery in Devonian dolomite some 1,200 ft below the Devonian top. Two follow-ups were unsuccessful, and production from the one well was disappointing. In 1956 Colorado Oil and associates went in, reworked the discovery for successful oil production, took up five drilling reservations, and have scored oil discoveries in the

SASKATCHEWAN DEVELOPMENT WELLS

Field	Tp.	R.	Mer.	OIL Wells	OIL Feet	GAS Wells	GAS Feet	DRY Wells	DRY Feet	SERVICE Wells	SERVICE Feet
Alameda	3,4	2,3	2	9	40,130						
Alida	5,6	33	1	22	83,735			4	15,353		
Battrum	18	17	3	2	6,040			1	3,004	2	1,743
Bone Ck.	10	19	3	23	102,253			1	4,471		
Cantuar	16	17	3					1	3,201	1	3,345
Carnduff	2	33,34	1	31	133,258			1	4,375		
Coleville	31	23,24	3	70	192,224					1	3,950
Dollard	7	20	3							1	4,400
Driver	31	24	3			2	4,588				
Eureka	31,32	22,23	3	9	21,736	1	2,327				
Frobisher	3,4	4	2	13	60,518	1	4,749	2	9,348		
Gainsborough	2	30	1	2	7,124						
Glen Ewen	2,3	1	2	2	8,731						
Halbrite	6	12	2					3	14,221		
Hastings	3-5	32-34	1	35	138,294			8	31,884		
Hoosier	30,31	27	3			3	7,295	2	4,876		
Instow	9	18	3	1	4,660						
Java	15	15	3					1	3,460		
Kingsford	4	6,7	2	59	287,136			3	14,840	1	4,946
Lampman	4,5	6	2	15	69,856						
Lloydm.	47-49	27,28	3	11	21,100			5	9,912		
Midale	6,7	10,11	2	97	453,683			5	23,255	2	7,099
Nottingham	4,5	31-32	1	44	164,125			4	14,732	1	3,597
Roncott	5	25	2	1	6,061						
Silverton	3	32	1	1	4,060						
Smiley	30,31	25,26	3	13	32,324						
Steelman	3-5	5,6	2	166	788,633			5	24,507		
Success	16	16	3	7	23,129			1	3,407		
Torquay	3	11	2	1	5,450						
Verlo	16	19	3	2	6,458			2	6,558		
Wapella	14	1	2					1	2,438		
Weyburn	6,7	13,14	2	53	247,810			2	9,279		
Whiteside	30	26	3	4	10,166						
TOTALS:				693	2,918,694	7	18,959	52	203,121	9	29,080

COMPARISON OF EXPLORATORY RESULTS—1956-1955-1954

	Completed Discoveries & Extensions: Total	Gas	Oil	Rate Gas	Rate Oil	Completed Exploratory: Total	Rate Gas	Rate Oil	% Total
1956									
Alta.	175	80	95	46%	54%	486	17 %	19.5%	36 %
Sask.	97	5	92	5%	95%	343	15 %	27 %	28 %
B. C.	12	12	0	100%	0	28	43 %	0	43 %
Man.	4	0	4	0	100%	71	0	6 %	6 %
N. W. T.	0	0	0	0	0	3	0	0	0
W. Canada	288	97	191	34%	66%	927	11 %	21 %	31 %
E. Canada	15	10	5	67%	33%	149	7 %	3.4%	10 %
Total Canada	303	107	196	35%	65%	1,076	10 %	18.2%	28 %
1955									
Alta.	148	70	78	47%	53%	412	17.0%	19.9%	36.0%
Sask.	68	15	53	22%	78%	362	14.3%	15.0%	19.3%
B. C.	13	12	1	92%	8%	36	33.3%	2.8%	36.1%
Man.	16	0	16	0	100%	69	0	23.2%	23.2%
N. W. T.	1	1	0	100%	0	6	16.7%	0	16.7%
W. Canada	246	98	148	40%	60%	885	11.1%	16.7%	27.8%
E. Canada	10	7	3	70%	30%	132	5.3%	2.3%	7.6%
Total Canada	256	105	151	41%	59%	1,017	10.3%	14.8%	25.2%
1954									
Alta.	152	66	86	44%	56%	363	14.3%	18.2%	32.5%
Sask.	65	19	46	29%	71%	342	4.4%	8.2%	12.6%
B. C.	14	14	0	100%	0	14	28.6%	0	28.6%
Man.	20	0	20	0	100%	87	0	23.0%	23.0%
N. W. T.	0	0	0	0	0	6	0	0	0
W. Canada	251	99	152	39%	61%	812	8.8%	14.0%	22.8%
E. Canada	10	10	0	100%	0	112	8.9%	0	8.9%
Total Canada	261	109	152	42%	58%	924	8.8%	12.3%	21.1%

Jurassic and uppermost Devonian and gas in the Permo-Pennsylvanian.

Simonette: A new pay was added when a well drilled in 1956 (Richfield-Cities Service 3 of 6, 63-2 W.6) was tested early in 1957, getting 112 b/d after a "frac" treatment from the Dunvegan (Upper Cretaceous).

Wild Well: Gulf Akuina (13 of 36, 66-3 W.5), with 13-in. casing, well cemented at 602 ft, was drilling on January 16, 1956 near the base of the Cretaceous at 2,720 ft—when there was a blowout, gas caught fire, burning the rig and cratering started. Prompt action was taken to start a directional hole, spudded five days later and finished drilling on February 25. By March 12, the fire was under control, and a week later the gas flow was decreasing. It marks another gas discovery of a size as yet unknown. Considering the large amount of drilling, accidents of this nature are few, and the occasional one merely cautions the industry to watch for trouble at all times. A subsequent well early in 1957, some 14 miles to the north, found oil in a horizon stratigraphically somewhere near the gas horizon.

Other new pays include: *B. A. Esther:* 6 of 32, 31-2 W.4, obtained gas from the Belly River. *Baysel Trail:* 15 of 30, 64-9 W.6, found gas in Chinook sandstone (Colorado). *Sinclair Dahl:* 7 of 7, 13-27 W.4, found oil with 23 b/d from a sand between Milk River and Fish scale, and tentatively named Dahl sand. There was also a good show of oil in the Fish scale. *B.A. Mountain Park:* 5 of 36, 47-2 W.5, found gas in the Triassic, a new horizon in this part of Alberta. *Mobil Leafland:* 12 of 16, 40-5 W.5, found both Cardium and Viking oil pay in a new area; and *Great Plains Crimson Lake,* 9 of 23, 40-9 W.5, got gas and condensate from the Cardium.

Others are: *Southern Production Pembina River:* 5 of 26, 47-15 W.5, found Cardium oil much farther west than other discoveries. *Stanolind Rat Creek:* 16 of 33, 48-11 W.5, found Viking oil in the western part of Pembina field where most production comes from the Cardium. *Richfield Lind:* 6 of 4, 16-27 W.4, and *Richfield Mazeppa,* 6 of 16, 19-27 W.4, found gas in the Mississippian. *Honolulu Paddle River:* 16 of 17, 56-8 W.5, found 288 b/d of 18 API oil in the Mississippian, the first sizeable oil of low gravity in this part of Alberta. Good extensions of Mississippian oil have been recorded in Harmattan field, Townships 31 and 32, Range 4, West 5th. *Hudson's Bay Beaver Creek:* 1 of 32, 56-19 W.5, found gas in the Wabamun, a new pay. *Brinkerhoff Ardrossan:* 13 of 26, 52-22 W.4, got 62 b/d in Nisku, with oil 39.7 API. *Charter Youngstown:* 6 of 24, 31-10 W.4, made the first Jefferson discovery since Princess in 1940, with 96 b/d of 31.4 API oil. The horizon is roughly equivalent to Nisku, but east of true Nisku biostrome—although Saskatchewan nomenclature carries the name across that province. *B.A. Klingstal,* 9 of 23, 33-26 W.4, with 148 b/d of 40.7 API oil, and *White Rose North Stewart Lake,* 1 of 4, 33-26 W.4, with 215 b/d of 40.7 API oil appear to be long extensions of Wimborne. Dome found the reef between Wizard Lake and Bonnie Glen, with thin pay in 1 of 5, 48-27 W.4. *Imperial Big Lake South,* 5 of 25, 53-26 W.4, which scored either a reef extension to the north of Acheson or a separate pool with 881 b/d of 40 API oil and good prospects in two horizons above the reef.

Also included are: *B.A. Lanaway:* 11 of 36, 35-4 W.5, found large gas in the reef some 40 miles south of Rimbey and somewhat west. In Saskatchewan, Mobil Oil at *North Roncott,* 9 of 34, 5-25 W.2, found 106

BRITISH COLUMBIA DEVELOPMENT WELLS

Field	Tp.	R.	Mer.	OIL Wells	OIL Feet	GAS Wells	GAS Feet	D & A. Wells	D & A. Feet	TOTAL Wells	TOTAL Feet
Boundary L.	85,86	13,14	6	5	21,650					5	21,650
Ft. St. John	82,83	17,18	6	2	8,910	23	119,520			25	128,430
TOTAL:				7	30,560	23	119,520			30	150,080

ALBERTA DEVELOPMENT WELLS

Field	Tp.	R.	Mer.	OIL Wells	OIL Feet	GAS Wells	GAS Feet	DRY Wells	DRY Feet	SERVICE Wells	SERVICE Feet
Alexander	56	1	5			1	4,126				
Alhambra	41,42	5,6	5	7	43,349			1	6,286		
Atlee-Buffalo	20,21	6,7	4			1	2,975	1	3,362		
Battle	46	20	4					2	6,605	1	3,288
Bellshill L.	41,42	12	4	17*	51,820	1	3,250	2	6,194		
Bentley	40	1,2	5	37	209,764			4	23,024		
Bindloss	22,23	3,4	4			5	10,977				
Bonnie Glen	47	27	4	6	42,025			1	7,000		
NW Cessford	25	15	4			1	3,625				
Crossfield	27	2	5			1	8,671				
Erskine	39	20,21	4	26	140,773			3	16,328		
Fenn	35-37	20	4	15	80,890			4	21,816	1	5,397
Gilby W.	41	3	5	4	26,373						
Giroux L.	65	20	5					1	10,132		
Gordondale	79	10	6			2	9,563				
Hamilton L	35	9	4	1	3,015			3	8,933		
Harmattan	31,32	4	5	37	339,872	1	9,090				
Homeglen-Rimbey	42-44	1,2	5	5	39,554	2	15,747				
Hussar	23,24	20,21	4			9	41,527	1	4,680		
Iroquois	75	19	5					1	7,955		
Joarcam	47	20	4	3	9,977						
Joffre	38,39	25-27	4	86	439,694	2	9,512	11	55,895		
Keystone	48	4	5	3	13,335						
Lloydminster	50	1,2	4	13	25,805			7	13,898	1	2,941
Makepeace	23	19	4			1	4,736				
E. Manyberries	5	4	4					1	4,182		
Medicine Hat	13	6	4			2	2,435				
Morinville	55	25	4					2	9,240		
Nevis	40	22	4			1	5,560				
Normandville	79	22	5	2	13,520						
E. Pakowki	4	7,8	4			1	2,228	1	2,178		
Parkland	16	27	4					1	7,800		
Pembina	46-50	6-11	5	855	4,458,987			1	3,645	1	5,450
Pincher Creek	4	29	4			1	12,244c				
Pinhorn	1	10	4			1	3,200				
Pouce Coupe	77,78	12,13	6			5	16,730	1	7,727		
Provost	35	7	4			1	2,916				
Redland	28	21	4					1	4,302		
Richdale	30	12	4			1	3,788	1	3,762		
Rocky Mtn. House	42	8	5	1	6,460						
S. Rosebud	26	21	4			3	14,692	1	4,890		
Rosedale	28	20	4					1	4,530		
St. Albert	53,54	26	4	3	14,126	1	3,996	2	9,992		
St. Paul	58	9	4			1	1,615	1	1,650		
Stettler	38	20	4	5	26,585			1	5,355	1	5,600
Sturgeon L.	71,72	23	5	5	44,485						
" " So.	68,69	21-23	5	45	375,426			2	11,940		
Suffield	15	9	4			5	6,045				
Sundre	33,34	5	5	18	165,662						
Tempest	9	19	4					1	3,554		
Turner Valley	19	2	5			1	6,198				
Viking-Kinsella	45	8	4			2	4,750				
Wainwright	45,46	6	4	54	121,740			4	9,198		
Westward Ho	33	4	5	6	53,224						
Winchell Coule	29	6	5					1	6,040		
Windfall	60	15	5			1	8,700				
TOTALS:				1,255	6,749,747	54	218,896	64	281,961	5	22,676

* Bellshill Lake includes 489 feet in an oil well counted in 1955.
c Actually condensate.

b/d of 41.4 API oil in the Bakken (Banff sand equivalent). Previous production from this horizon at Coleville is heavy gravity. *Canadian Oil Companies* recorded a long extension of Weyburn field in 16 of 17, 6-13 W.2, with exceptionally thick pay reported at 91 ft. Several wildcats in southeast Saskatchewan have marked the fields of Carnduff, Glen Ewen, and Alameda—with new pools in Hastings and Nottingham fields. A little farther north, Queensdale field is shaping up following a 1956 discovery. In British Columbia discoveries have been gas or gas and condensate—with Triassic as the producing horizon in four cases, Permo-Pennsylvanian in two, Mississippian and Devonian in two each.

Secondary Recovery: Pembina field, with dissolved gas as the only producing mechanism, had a prospect of only 13% recovery factor. James A. Lewis Engineering Ltd. made a study of four lease blocks in the southern part of the field, and recommended early pressure maintenance, as covered elsewhere in this issue.

Significant Dry Holes: If we listen to any authority, every exploratory dry hole is significant. Dr. A. I. Levorsen emphasized this at the regional AAPG meeting in Salt Lake City recently, when he remarked on the transition now going on from the drilling of structures to the drilling of stratigraphic traps. From this standpoint, there were some 600 significant dry holes in western Canada—almost two a day over the year—from which the industry can study changes in facies and look for pointers as to where oil is to be found. To select the most significant ones to study first would be to know where the land holdings of every company lie. To each company the most significant ones will be different; and, if samples were taken at 10-ft intervals and all of them are to be studied, some 280,000 samples will need to be examined. The average dry wildcat in 1956 had a depth of 4,850 ft, and many of them penetrated all or nearly all of the sedimentary section.

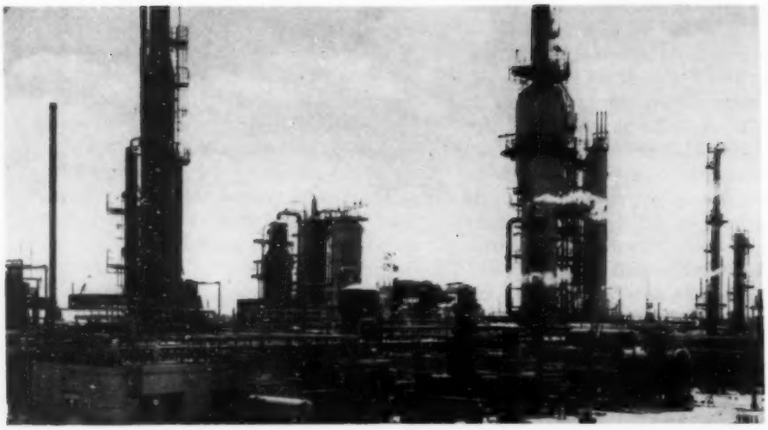
We might point out that four wells in the Red Deer-Penhold area gave reef control. In Saskatchewan some 9 holes went to basement, and two holes to Cambrian, while in Manitoba five holes gave basement control. END

TOTAL WELLS DRILLED IN WESTERN CANADA—1956

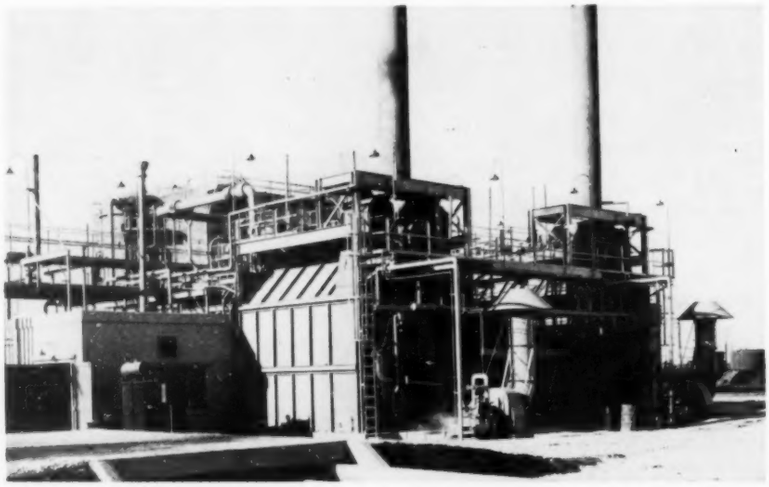
Province	Finding Oil		Successful Wells Finding Gas		Finding Condensate		D. & A.		Service Wells		Totals	
	No.	Footage	No.	Footage	No.	Footage	No.	Footage	No.	Footage	No.	Footage
Alberta												
New Field Wildcats	27	248,630	41	169,709			230	1,286,722			298	1,705,061
New Pool Wildcats	11	55,891	14	76,598			25	110,480			50	242,969
Shallower Pool Test	1	4,750[a]	3	14,219[a]							4	18,969
Deeper Pool Tests			3	13,150			18[c]	73,176			21	86,326
Outposts	53	314,181	19	91,749			33	166,030			105	571,960
Exploratory Total	92	623,452	80	365,425			306	1,636,408			478	2,625,285
Development Wells	1,255	6,749,747	54	218,896			64	281,961	5	22,676	1,378	7,273,280
TOTALS FOR ALTA.	1,347	7,373,199	134	584,321			370	1,918,369	5	22,676	1,856	9,898,565
Saskatchewan												
New Field Wildcats	24	111,817	3	9,322			195	795,444			222	916,583
New Pool Wildcats	25	113,774	1	3,220			30	124,356			56	241,350
Deeper Pool Tests	1	4,590					5[e]	26,289			6	30,879
Outposts	41	184,043	1	3,134			21	89,028			63	276,205
Exploratory Total	91	414,224	5	15,676			251	1,035,117			347	1,465,017
Development Wells	693	2,918,694	7	18,959			52	203,121	9	29,080	761	3,169,854
TOTALS FOR SASK.	784	3,332,918	12	34,635			303	1,238,238	9	29,080	1,108	4,634,871
Manitoba												
New Field Wildcats	1	4,300					40	113,949			41	118,249
Outposts	3	6,369									3	* 6,369
Exploratory Total	4	10,669					40	113,949			44	124,618
Development Wells	187	407,883					15	36,694	8	12,670	210	457,247
TOTALS FOR MAN.	191	418,552					55	150,643	8	12,670	254	581,865
Northwest Territories												
New Field Wildcats							3	6,038			3	6,038
Development Wells	4	6,450									4	6,450
TOTALS FOR N.W.T.	4	6,450					3	6,038			7	12,488
British Columbia												
New Field Wildcats			8	58,788	2	19,800	12	77,423			22	156,011
Deeper Pool Tests					1	6,845[e]	1	7,105[f]			2	13,950
Outposts							3	14,688			3	14,688
Exploratory Total			8	58,788	3	26,645	16	99,216			27	184,649
Development Wells	7	30,560	23	119,520							30	150,080
TOTALS FOR B.C.	7	30,560	31	178,308	3	26,645	16	99,216			57	334,729
Western Canada												
Exploratory	187	1,048,345	93	439,889	3	26,645	616	2,890,728			899	4,405,607
Development	2,146	10,113,334	84	357,375			131	521,776	22	64,426	2,383	11,056,911
TOTALS FOR W. CAN.	2,333	11,161,679	177	797,264	3	26,645	747	3,412,504	22	64,426	3,282	15,462,518

[a] In Alta. Expl. footage Shallow Pool Tests oil 5,480, gas 10,512.
[b] In Alta. Expl. footage Successful Deeper Pool Tests 5,427.
[c] In Alta. Unsuccessful Deeper Pool Tests, 6 got oil, 3 got gas in usual horizon. Expl. footage 25,536.
[e] In B.C. Successful Deeper Pool Tests, exploratory footage 297.
[f] In B.C. Unsuccessful Deeper Pool Tests, 1 got oil in usual horizon, 705' exploratory.
Note: 1 N.F.W. apparent gas well held to 1957 pending test.
In Alberta, 1 development well (Pincher Creek) shown as a gas well, is actually condensate.
* In Sask. Unsuccessful D.P. Tests, 3 got oil, 1 gas in usual horizon.

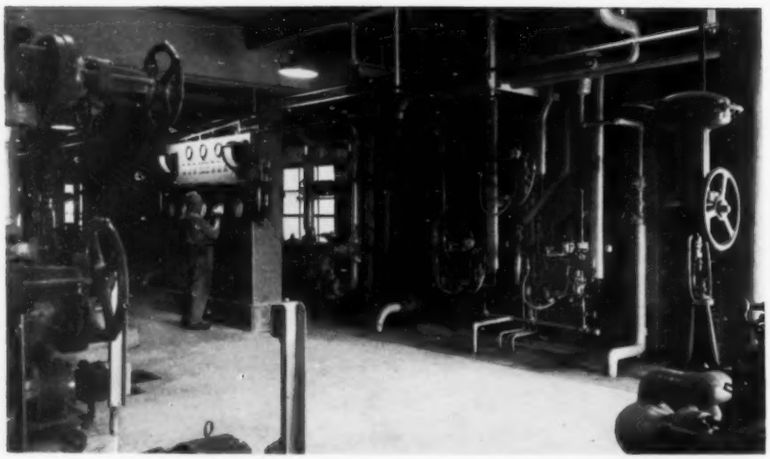
NORTH WINNIPEG



North Star's Winnipeg refinery: A general view of part of the process battery—with the Orthoflow fluid catalytic cracker (right, center) and the atmospheric crude tower (left).



Outer end of the steam boilers in the utility plan—with a corner of the utility plant building shown at the left and the cooling towers in the background.



Firing end of the boilers inside the utility plant building at the North Star Winnipeg refinery.

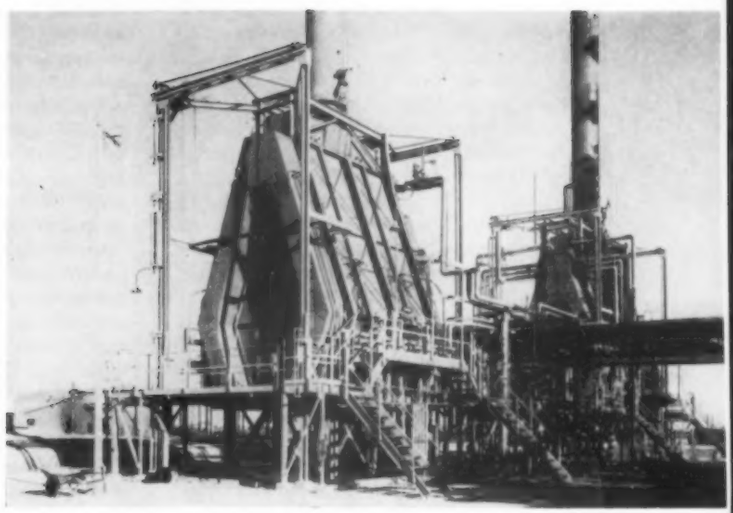
Charles E. Marks has been with The M. W. Kellogg Co. since 1939, and has had experience in refinery economics, process design, and development and field operating. He is now in the technical service section of the company, and in this capacity followed the progress of the North Star refinery during its first year of operation. While there, he acted as observer, advisor, and general "trouble shooter."

Mr. Marks holds a degree in chemical engineering from Vanderbilt University, and did graduate work at the Georgia Institute of Technology. He is an ACS member.

STAR'S NEW REFINERY

By Charles E. Marks

and George C. Patterson



Two furnaces for the crude distillation unit.

Since 1952 George C. Patterson has specialized in offsite work at The M. W. Kellog Co., and is now an assistant section engineer in the company's piping offsite section. He was in charge of all refinery planning and piping engineering work for the North Star refinery, and previously for Imperial Oil's lube plant at Edmonton, Alberta.

Mr. Patterson has been with M. W. Kellogg for 10 years. He is a graduate of the Polytechnic Institute of Brooklyn; holds a professional engineer's license in the state of New York; and is an API member.

NORTH Star Oil's new 12,000 b/d refinery near Winnipeg has now been in operation for more than a year. It is the major element in an expansion program which has brought this company into the front rank of western Canadian marketers.

The new installation replaces an earlier 4,000 b/d plant, operated by North Star for many years on a nearby site. Shortly before the new plant was commissioned, the older one had been shut down. Much of its equipment was then dismantled and shipped to Grande Prairie, in the Peace River district of northern Alberta, to become the nucleus of another refinery there. The Grande Prairie plant is also now in operation.

The new Winnipeg refinery represents an overall investment of some $12 million. It was conceived and built as a completely new entity from the ground up—including tank farm, loading racks, boiler house, shops, laboratory, and offices and other necessary auxiliaries. The entire job was embodied in a single contract, awarded to Canadian Kellogg Co. Ltd.—with design work furnished by The M. W. Kellogg Co.

Location, Layout, and Site Preparation: The plant site, in the city of St. Boniface, Manitoba, is only four miles from the center of Winnipeg. It occupies a generally level plot of 173 acres, located on a main highway and served by both the Canadian National and Canadian Pacific railways. Refinery layout, illustrated in the plot plan (Fig. 1), is quite compact—serving to centralize major facilities and minimize piping runs.

Crude oil is received from the Gretna-Winnipeg spur of the Interprovincial Pipeline, which carries Alberta crudes, primarily, from Edmonton to the Great Lakes.

Soil conditions in and around Winnipeg are such that piling had previously been used to support all heavy industrial and commercial structures in the region. To facilitate construction of the new refinery, it was decided to eliminate the use of piles. Instead, as a typical instance, the entire process area was excavated to a depth of 10 ft below grade, then back-filled with 4 ft of compacted gravel. Footings and piers corresponding to the 6-ft depth of frost line were then placed directly on the gravel base. The same procedure was followed in other heavy load-bearing zones of the plant. Future equipment additions in each such area will be greatly simplified, since subfooting preparation will not be required.

Process Battery: The refinery features a simple, highly integrated processing scheme, incorporated in a compact combination battery. As shown in the flow diagram (Fig. 2), the major processes involved are two-stage crude distillation, fluid catalytic cracking, and catalytic polymerization. The fluid catalytic section is of the Orthoflow† model-B type, with regenerator placed above reactor in a single vessel.

The plant has been designed for extensive heat interchange within each section and between different process stages, so as to minimize extraneous energy requirements and cooling-water usage. Feed components normally flow hot from crude distillation directly to the cracking unit and, as a consequence, the cracker does not require a preheat furnace. For the entire battery, in design operation, the total process heating duty from "external" sources consists of

† Trademark of The M. W. Kellogg Co.

40,000,000 Btu per hour in the atmospheric and vacuum crude furnaces—including their steam superheating coils—plus some 6,000,000 Btu per hour in various steam-heated exchanger items. Approximately half of this total duty is recovered in the form of high-pressure steam generated by two waste-heat boilers in the cracking plant.

Light ends from crude distillation and catalytic cracking are combined in a single gas-recovery section. One compressor delivers gas from both sources to the absorber tower for selective recovery of C_3 and C_4 components. The gas compressor and the regeneration air compressor in the cracking unit are both centrifugal machines. The two compressors, which are driven by electric motors, represent 80% of total driver horsepower normally operating in the process units.

The straight-run gasoline-treating system consists of three elements in series: (1) a batch caustic wash; (2) a circulating, regenerative caustic wash; and (3) a slurry-type copper-chloride sweetening unit. Sulfur compounds are removed from poly feed by DEA treatment, followed by batch caustic wash. Treating operations on other product streams are indicated in the flow diagram (Fig. 2).

While retaining the investment and operating economies of combination processing, the plant has a considerable degree of flexibility. Thus, jet fuel can, and has, been made by minor changes in operating conditions and product routing. To meet more drastic shifts in the marketing picture, provision has been made in plan layout and process design for specific future additions. For example, the existing equipment is designed to tie in with a future coking unit, should there be a decline in residual fuel-oil demand. The only intermediate storage in the present system is a single 55,000-bbl tank for catalytic cracker feed. This is ordinarily unused, but is provided so that either side of the battery can run independently for a period, with the other section shut down.

Physically, the process vessels, exchangers, and most other equipment are arranged in two rows which flank each of the two in-line pump houses, over whose roofs runs the main pipe alley. All process equipment —including treating, catalyst storage, and such auxiliaries as spent-caustic neutralization and foul-condensate stripping—is contained within one plot occupying less than two acres. To obtain maximum advertising value, the process battery was placed near a highway bordering the property, and was painted in bright primary colors. The side of the control room directly adjacent to the highway is a continuous window, affording a full view of the instruments and graphic panels to passing motorists.

Operating Staff: Integration of processes, compactness of plot, and unified control enable the refining battery to be run by only eight operators, excluding a shift foreman whose duties extend over a wider area.

Tankage and Product Handling: Because of the dependability of pipeline crude supply, crude storage has been provided for only 12 days at design charge rate (three 55,000-bbl tanks). Crude is stored in cone-bottom tanks, fitted with high and low suction connections, which permit continuous withdrawal of bottom sediment without use of mixers or sludge-recirculation pumps. A total of about 750,000 bbl of tankage is provided for product storage. Due to the great seasonal variation in markets, much of this product is stored in the form of components, rather than finished blends, and provisions are made for change of service in some tanks. A number of tanks from the old refinery were moved on skids—some as far as ½ mile—to the new site (this was the only instance of equipment transfer between the two plants). Since the operation of each refinery was dependent upon availability of these tanks, their movement had to be tightly scheduled in order to give a minimum interval between shutdown of the old plant and startup of the new one.

Sales products include two grades of motor gasoline, farm-grade gasoline, tractor distillate, jet fuel, diesel oil, stove oil, furnace oil, bunker fuel, and propane LPG. Gasoline components are line-blended, under flow control, into final products. Additives such as TEL and dye are then mixed in batchwise, in the relatively small final product tanks. This combination of line and batch mixing was found to be the cheapest and most efficient blending method for the plant under consideration.

All products manufactured in the refinery are handled at one centrally located transfer pumphouse. Rail shipping facilities, which are furnished for all products, permit loading of 36 tank cars at one time. The truck-loading racks are somewhat removed from the rest of the plant, to afford segregated access by vehicles. Eighteen spots are provided at these racks, making them adequate for all seasonal peaks without piping changes. Miscellaneous product-handling facilities include a drum-filling plant.

Utilities and Auxiliary Facilities: The central steam-generating equipment consists of two boilers, each capable of producing 50,000 lb per hour of 175 psig superheated steam. Their output, of course, is supplemented by waste-heat steam generation in the catalytic cracking unit. The boilers are unsheltered except for the firing aisles, which are housed in the utility plant building. This building also contains the water-treating facilities, air compressors and instrument air dryer, and pumps for boiler-feed, cooling, and fire water. A two-cell cooling tower is located nearby.

Because of the extremely low cost of purchased power in this region, electric motor drivers are used predominantly throughout the refinery. Dual 62,000-volt feeders, with automatic switchover, supply the main substation, which is adjacent to the utility plant building. Power is distributed to points of use at 4,160 volts.

Water for all purposes is obtained from a local utility, the Greater Winnipeg Water

Fig. 1. North Star plot diagram.

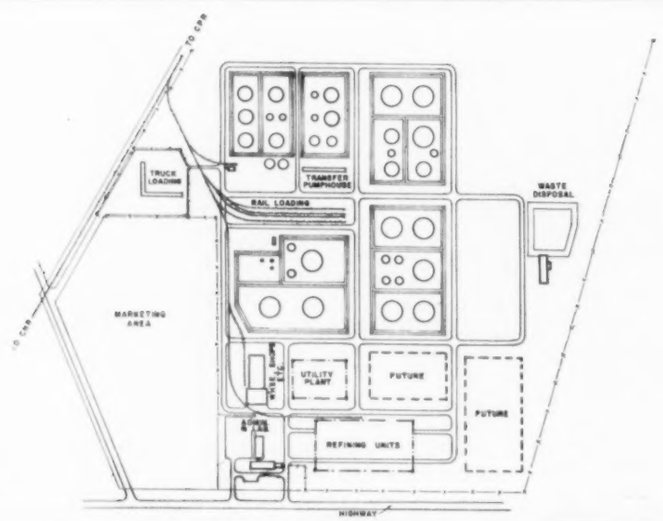
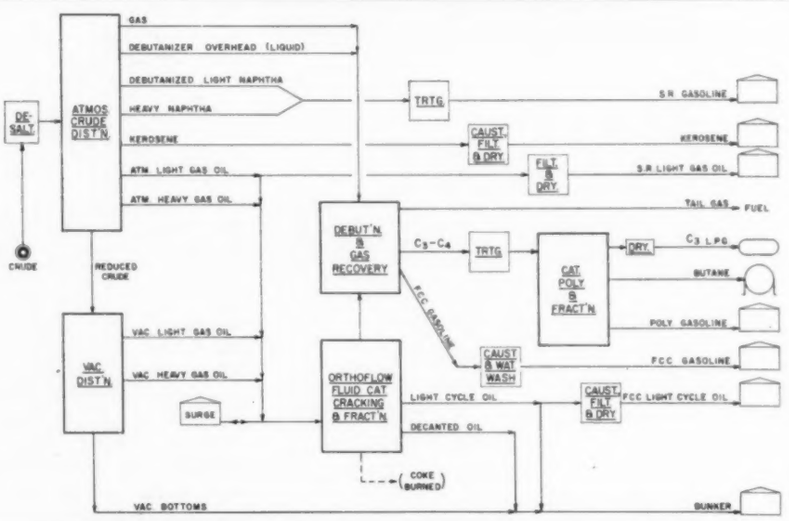


Fig. 2. Process flow diagram of North Star plant.



District (use of well water had been contemplated, but test wells drilled on the plant site had insufficient capacity).

All effluent water goes into the city sewer system via a holding basin, refinery waste water having first passed through an API separator. Additional anti-pollution measures, such as stripping of foul condensate water with cracker flue gas, are carried out within the process battery. Sulfur-bearing gases from process treating operations are disposed of in a furnace or boiler.

A single large maintenance building houses shops, warehouse, garage, change house, and lunch room. Offices and gate house are combined in another structure, which is connected by an enclosed passageway to the laboratory building.

Operating Results: Refinery output is best exemplified by the data of an eight-day run made in August 1956, when the plant was operating very near design conditions throughout. The crude-oil feed at this time was a mixture of 90% Redwater and 10% Smiley.

Table 1 is an overall balance for this period on the basis of primary rundown products, with the process battery aligned as in the flow diagram (Fig. 2) and with the FCC feed surge tank shut off. Except for the bunker-fuel constitutents, all oil rates in the table represent 8-day tank-gage averages.

As shown in Table 2, total gasoline constituents represent 54% of crude—with a pool octane number (on addition of 3 ml TEL per gallon) of 91.7. The vapor pressure of the blend, 11.4 psi, signifies a near-perfect butane balance for year-round operation with this product structure. Naturally, withdrawal of some straight-run naphtha to jet fuel or tractor distillate will raise the pool octane number and throw butane into excess. It should be noted that octane blending values of the two catalytic gasolines are considerably higher than the individual octanes shown for these streams in Table 2.

As indicated in the flow diagram (Fig. 2), catalytic cracker "fresh" feed is entirely composed of virgin distilled gas oil—representing the crude fraction immediately above 12.6% vacuum bottoms. Other fresh-feed data follow:

Gravity, deg API	26.6
50% point (ASTM) of distillation, F	670
% by volume of crude	39.3
Barrels per day	4,798

FCC heavy gas oil, the portion of reactor effluent between so-called light-cycle and decanted oils, is recycled to extinction. The recycle rate during test run was 3,830 b/d, or 80% of fresh feed. At this condition, and with an average reactor temperature of 909 F, a fresh-feed conversion of 70% was obtained. FCC gasoline yield, corrected to a C_5-400 F basis, was 49.0% of fresh feed.

Synthetic catalyst has been used exclusively in this unit. The catalyst addition (and loss) rate during the period under consideration was about 0.6 ton per day. It has not been necessary to withdraw any used catalyst for activity maintenance.

The two steam-generating exchangers in the FCC fractionator system produced 24,000 lb per hour of 190 psig steam during test-run operations. This was approximately equal to the quantity of steam which currently was being made in the utility plant boiler, under prevailing summer conditions.

An innovation in the design of the FCC fractionator was the use of perforated trays. The quality of the fractionation obtained is illustrated by the separation between the tower overhead gasoline and the first sidestream, light-cycle oil, which is drawn from the eighth tray and then steam-stripped. The test-run average ASTM distillations of these products, in part, are:

Gasoline:	
90% point, F	356
End point	406
Light-Cycle Oil:	
Initial boiling point, F	406
10% point	474

Interpolation indicates a 95%-5% gap of about 75 F. During early operations, several instances of fractionator flooding carried appreciable quantities of catalyst at least as high as the cycle-oil drawoff. However, the drawoff streams always cleared up as soon as flooding was suppressed, and the perforated trays (3/32-in. holes) never showed any evidence of having been plugged.

Feed to catalytic polymerization during test run was 1,480 b/d, containing 36 mol % of propylene and butylenes. Some 95% of these olefins were converted to polymer gasoline.

Orthoflow fluid catalytic cracker and catalytic fractionator at North Star's Winnipeg refinery—with central pipe alley and pumphouse in foreground.

In the straight-run gasoline treating systems, the caustic washes remove around one-third of the mercaptan sulfur originally present in the gasoline—typically from 0.027% to 0.017% mercaptan sulfur. The copper-chloride treater, which follows the caustic washes, produces a doctor-sweet gasoline. Chemical-consumption rates in the latter unit, relative to gasoline feed, for a recent two-month period have averaged:

Copper chloride	2.1 lb per 1,000 bbl
Fullers earth	8.4 lb per 1,000 bbl
Oxygen	0.22 SCF per barrel

Job History: The job contract was awarded to Kellogg on March 5, 1954, at which time design engineering was begun.

In April, some earth-moving operations were started at the plant site. Construction work proper commenced early in June of 1954, and was finished almost exactly a year later.

Before completion of construction, operating personnel began conditioning and checking equipment as it became available to them. On June 25, 1955, they brought the crude-distillation unit onstream, and the other units followed soon afterward.

END

TABLE 1
OVERALL PLANT BALANCE

	% by Volume	B/D	Gravity (API)	% by Weight
Crude	100.0	12,221	34.7	100.0
SR gasoline	25.5	3,120	58.7	22.3
Kerosine	15.3	1,865	39.7	14.8
SR light gas oil	2.0	244	35.4	2.0
FCC gasoline	19.9	2,432	58.6	17.4
FCC light cycle oil	6.4	788	25.6	6.8
Poly gasoline	3.6	439	63.5	3.1
Butane	5.2	629		3.5
Propane LPG	2.5	302		1.5
Bunker fuel	17.6	2,156	11.1	20.5
Recovered slop oil	0.7	90	35.0	0.7
Tail gas				2.0
FCC coke				4.9
Salt and water				0.4
Total product	98.7	12,065		99.9
Bunker Breakdown:				
FCC light cycle oil	3.4	415	25.6	
FCC decanted oil	1.6	194	3.8	
Vacuum bottoms	12.6	1,547	8.5	
Total bunker	17.6	2,156		

TABLE 2
TOTAL GASOLINE POOL

	B/D	% by Volume on Crude	% by Volume of Gasoline Pool	Reid Vapor Pressure (PSI)	Research Octane No. (Clear)	Research Octane No. Plus 3 Ml TEL Per Gallon	ASTM End Point (F)
SR gasoline	3,120	25.5	47.2	3.4	57.2	75.6	380
FCC gasoline	2,432	19.9	36.7	7.1	92.5	97.8	406
Poly gasoline	439	3.6	6.6	7.8	95.3	99.6	420
Butane	629	5.2	9.5				
Total pool	6,620	54.2	100.0	11.4	80.6	91.7	

PETROCHEMICALS IN CANADA

Sarnia's "Chemical Valley" and Montreal's Oil-Refining Center are the scene of major expansion in Canada's half-billion-dollar petrochemical industry. The Dominion is becoming self-sufficient in a growing number of chemical intermediates.

THE petrochemical industry in Canada represents a current investment of about $500 million on the part of some 30 companies at 37 locations in various parts of the Dominion. Production has tended to be concentrated at Sarnia and Montreal, where refinery tail gases are available in large quantities, and on the prairies where there are ample supplies of natural gas.

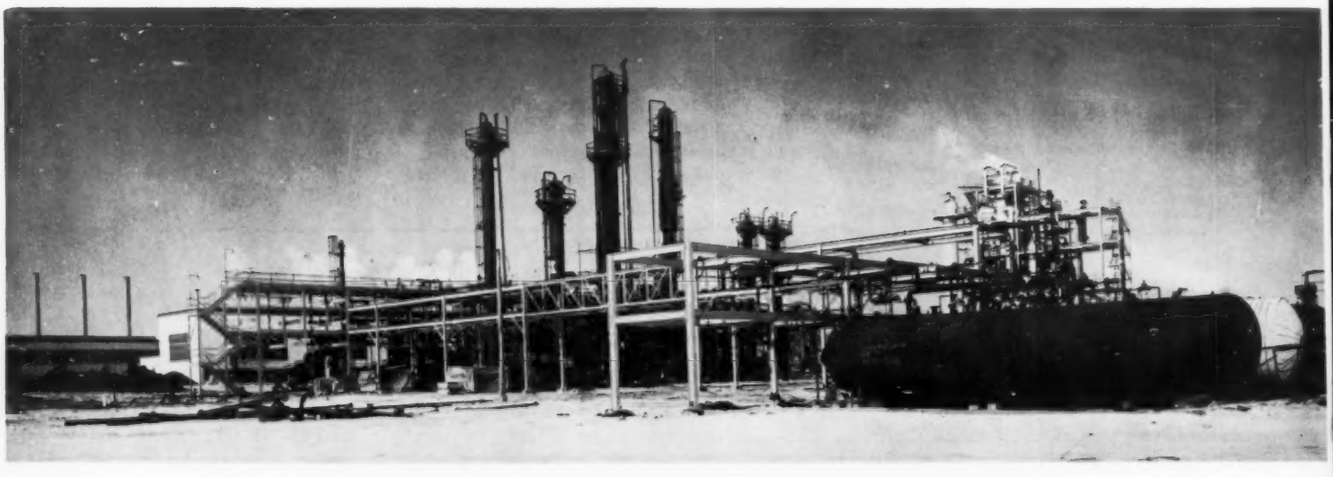
Largest additions to the industry at the moment are being made in the provinces of Ontario and Quebec. Imperial Oil Ltd. is beginning construction at Sarnia of a $25 million plant for the production of a wide range of petrochemicals based on ethylene, Imperial's neighbor, Dow Chemical Co. of Canada, currently is spending $10 million. Polymer Corp. has been expanding at a more or less continuous rate as raw materials became available since the Crown corporation was formed during World War II to produce synthetic rubber. It has been reported also that du Pont Co. of Canada is planning to erect a large petrochemical plant in the Sarnia region. Canadian Oil Companies Ltd. currently is installing equipment for the segregation of aromatics.

In the Montreal area, Union Carbide Canada Ltd., BA-Shawinigan Ltd., and Shell Oil of Canada are engaged in expansion of facilities.

On the prairies additional sulfur-producing capacity will be required for treating sour gas to be carried by both West Coast Transmission and Trans-Canada lines. New fertilizer capacity was completed in Alberta in 1956.

Growth of the petrochemical industry in Canada has been attained largely in the past dozen years. At the end of the war the industry consisted primarily of the $48 million synthetic-rubber plant of Polymer Corp., which then was producing 88 million pounds of rubber yearly valued at $28.5 million. In 1956 petrochemical production in Canada totaled about 710 million pounds, with a value of $127 million. By 1960, it is estimated that value of the output will be double that attained in 1955.

A view of the petrochemicals operation at Montreal East plant of Carbide Chemicals Co. Division of Union Carbide Canada Ltd.



Perhaps the largest plant now being built in Canada is the $25 million installation just getting under way on a 50-acre tract adjacent to the Sarnia refinery of Imperial Oil Ltd. Imperial's new plant will make available to the Canadian chemical industry large volumes of ethylene, propylene, normal butylenes, isobutylenes, butadiene, aromatic distillates, and aromatic tars for further processing. Other products can be added as they are needed by the Canadian chemical industry.

The new plant's ethylene capacity will more than double that of the entire country. It will also produce the first butadiene to be made in Canada by a private industry. Butadiene and butylenes will be supplied to Polymer Corp. for use in manufacturing synthetic rubbers.

Other chemical plants are expected to be built in Sarnia to make use of the new source of basic chemicals. When further processed, the new plant's output will end up in consumer's hands in the form of synthetic fibers, detergents, antifreeze, gasoline additives, plastic articles, and a number of other objects used in everyday life. The expansion of the Canadian chemical industry based on the new plant could be many times greater than the plant itself. Sarnia, already an important chemical center, is strategically situated for further growth because it has an assured supply of western Canadian crude oil for its refineries, is near the Canadian chemical markets, and on the St. Lawrence Seaway system. The location, plus the continuous supply of basic chemical raw materials which will be available from the new plant, should attract new plants there. Recent purchases of land adjacent to the refinery were part of the company's plans to foster the growth of allied chemical plants in Sarnia and to provide them with sites.

Imperial is a relative newcomer to the petrochemical field. Policy until recently has been to concentrate its efforts in finding and refining oil. Refinery off-gases have been sold to other processors. In 1955 the company organized its chemical-products department, and announced plans to erect a $38 million plant at Sarnia for the production of detergent alkylates. This plant will be completed about the middle of 1957. It will produce about 30 million pounds per year, calculated to be adequate to supply Canada's current needs for dodecyl benzene. The plant also will produce tripropylene and tetrapropylene, and alkyl aromatics.

The phenomenal growth of the petrochemical industry is illustrated in the case of Dow Chemical of Canada Ltd., which currently is spending $10 million on expansion at its Sarnia, Ontario, plant. This raises Dow's capital investment in plant facilities in Canada to more than $50 million. Although the company incorporated in Canada in 1942 (at which time it was helping to run the government-owned Polymer Corp.), Dow broke ground for its first plant only 10 years ago. Since then construction crews have never left the property; and capital investment has continued at a rate in the region of $500,000 per month.

Among Dow's major expansion plans are:

Ethylene: Basic material for antifreeze, synthetic fibers, resins, plastics—production being expanded 100%.

Ethylene glycol: Dow, already the biggest producer, is upping production 30% to 35%.

Ethanolamines: Used to purify natural gas, make detergents. New plant went onstream, December 1956, to meet skyrocketing demand.

Pentachlorophenol: Essential chemical wood preservative—used on telegraph poles, railway ties, fence posts, farm buildings. New plant now building will go onstream early in 1957; will be Canada's first.

Chlorine: Basic chemical for mining and pulp industries—used in making household bleaches, purifying drinking water. Production being boosted 30% to 35%.

Styrofoam: Newest wonder substance in building; tremendously light and durable; used for insulation; now being applied in houses and buildings as combination insulation and plaster base. Engineering on the new plant for styrofoam is now under way.

Styron: Plastic now seen everywhere in wall tile, toys, packages, refrigerator parts, kitchen utility dishes, etc. Expansion is under way.

Latex: The basic ingredient of rubber base paint. Mounting demand has resulted in earlier scheduling of additional production facilities.

The frothy Styrofoam, already in commercial use, may soon be the insulator for thousands of Canadian homes. This will have far-reaching effects in the building industry. Even Eskimos may have an age-old problem solved. Recently Dow shipped to a Department of Northern Affairs post on Baffin Island a replica igloo made of Styrofoam. Snow igloos tend to melt in the summer, so an official of the department's arctic division decided to test the snowlike plastic insulator as a substitute for the real thing.

The familiar restaurant "take out" cup for coffee and soft drinks is making its appearance in a new plastic dress. Already being tried in some Canadian centers, the plastic cup offers the advantages of greater cleanliness, transparency, and durability at competitive prices.

Wearers of false teeth may soon have them made of Styrex—a thermoplastic which blends styrene and acrylonitrile. The brush to clean them with, and the cup to soak them in, can be made of the same material.

When Canadian Oil Companies Ltd. built its new refinery at Sarnia in 1953, its old plant at Petrolia was purchased by S. Nord Chemical Co. Ltd. and converted to the distillation of pure aromatics from various sources. Platformate and coal-tar distillates have been processed. Nord was the first supplier of nitration-grade benzene in Canada. Output of the various aromatics totals about 30 million gallons yearly.

Canadian Oil Companies initiated studies in petrochemical construction during 1955, and in 1956 these culminated in a decision to install a new Platformer and Udex unit in the refinery for manufacture of benzene,

The plastics plant in Belleville, Ontario, of Bakelite Co. Division of Union Carbide Canada Ltd.

Shell Oil Co. of Canada's gas and sulfur plants at Jumping Pound, Alberta.

toluene, and xylenes. Completion of this plant is scheduled for summer of this year.

Another major producer of petrochemicals in Canada is Union Carbide Canada Ltd., whose subsidiary, Carbide Chemicals Co., will soon place onstream at Montreal East a fully integrated $25 million plant producing ethylene, polyethylene resin, ethylene oxide, ethylene glycol, the ethanolamines, glycol ethers, polyglycols, isopropanolamines, as well as other derivatives of propylene oxide and ethylene oxide. Some of these chemicals have never before been made in Canada.

The plant is in partial operation, now producing ethylene glycol, the ethanolamines, polyethylene resin compounds, and canned ethylene glycol antifreeze. Capacity of the polyethylene resin plant is somewhat more than 30 million pounds per year.

Ethylene and propylene are Carbide's raw material, and these will be produced from gases purchased from the nearby oil refineries. The ethylene will be used to produce polyethylene resin by the high-pressure process. Any unconverted ethylene from this resins' production unit, together with ethylene from the ethylene unit, will then form an economical feed stock for the production of ethylene oxide. A significant feature of the chemicals-producing unit is its flexibility. This means that small quantities of specialized chemicals can be "tailor-made" to a customer's specifications. The result will see many new chemicals being made in Carbide's plant which were not economically possible before in Canada.

The uses for the petrochemicals to be produced at Carbide's new plant are many and varied. For example, the ethanolamines have major applications in detergents and for removing hydrogen sulfide and carbon dioxide from natural and refinery gases. The diethylene and triethylene glycols are valuable for dehydrating natural gas—enabling it to be transported through pipelines without causing corrosion and hydrate formation. The glycol ethers are unique universal solvents, and are used in brake fluids, lacquers, and other applications. The polyethylene glycols are useful mold-release agents, and are intermediates in the manufacture of cosmetics and drugs. The polyalkylene glycols have wide application as specialty lubricants, in brake fluids, hair dressings, and as defoamers.

Bakelite Co., another of Union Carbide's divisions, operates a plant in Belleville, Ontario, which uses raw materials from petrochemical sources to make phenolic resins, laminates and molding compounds, and formaldehyde. The basic raw materials processed by the Belleville plant are phenol and synthetic methanol, and are obtained from other Canadian petrochemical sources.

BA Shawinigan Ltd. now is completing an addition to its phenol plant at Montreal East. The plant, which is the first in the world to produce phenol and acetone from cumene, has been in operation since 1953. It is jointly owned by British American Oil Co. and Shawinigan Chemicals Ltd.

When originally built, the plant was designed to produce 13 million pounds per year of phenol and 8 million pounds of acetone. Actual production has been higher than design capacity. New construction, now about complete, will increase capacity by 50% and permit the company to supply Canada's entire needs for this product.

A new product to be manufactured by the enlarged plant is hexylene glycol, a derivative of acetone. The new facilities are expected to supply Canada's entire consumption of the product, which is used in heavy-duty brake fluids and as a penetrant in printing inks. It also has a potential use as an anti-icing additive for gasoline.

Cumene for the BA-Shawinigan plant is supplied by British American's nearby refinery. Shawinigan Chemical supplies the benzene.

The petrochemical manufacturing activities of Shell Oil Co. of Canada Ltd., since its inception some four or five years ago, have been centered on the use of two types of raw material at widely separated locations—natural gas at Jumping Pound, Alberta, and refinery gas at Montreal, Quebec.

Operations at both points have been expanded to take care of growing demands and, in addition, product diversification is proceeding at Montreal.

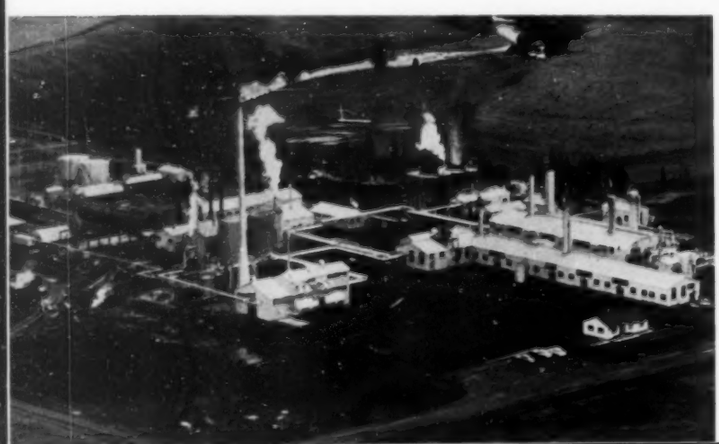
At Jumping Pound, the recovery of elemental sulfur from natural gas has been more than tripled from the original figure of 10,000 short tons per year—reflecting the industrial growth of the Prairie Provinces. The greater portion of this sulfur is being sold to plants which were not in existence when the sulfur plant was built—for the manufacture of sulfuric acid, which is used in the leaching of uranium and other ores and for byproduct fertilizer manufacture.

A production of 35 million pounds of isoproply alcohol and acetone was obtained in the Montreal chemical plant in 1956. This high production, compared to a design of 20 million pounds, was achieved as a result of improved operating techniques and a bottleneck removal program. Shell's chemical-solvent supply position was diversified when facilities to produce secondary butyl alcohol (SBA) and methyl ethyl ketone (MEK) commenced operation in March 1957. An unusual design permitted efficient utilization of a considerable part of the existing IPA—DMK plant, and provided a plant capable of making 1½ million pounds per month of secondary butyl alcohol and methyl ethyl ketone. The new production will replace products now imported from the United States. The principal uses for secondary butyl alcohol and methyl ethyl ketone are as a solvent in the paint and plastics industries, in the production of ore flotation agents, and as a solvent in the manufacture of lubricating oils. The feed stock for the unit is refinery butylenes. A byproduct of the operation will be high-octane polymers suitable for inclusion in premium gasolines. The new unit was engineered and constructed by Shell's Montreal refinery group.

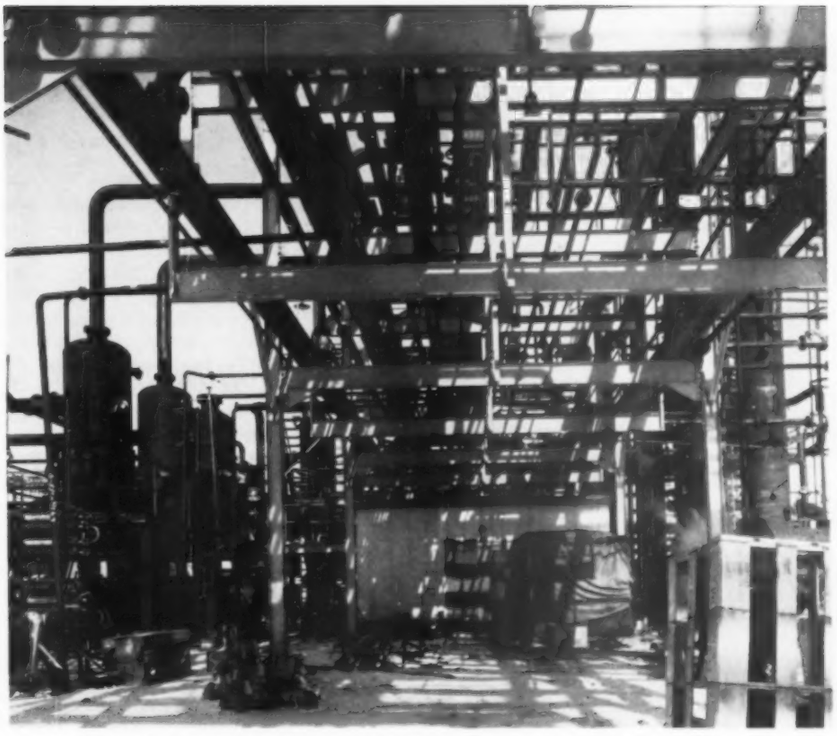
The first Canadian plant to produce epoxy-type resins will be in production within a year, according to Shell Oil Co. of Canada Ltd. The $1 million plant will be situated alongside Shell's present Montreal East chemical plant to produce enough EPON (trademark) resins to supply Canada's present and anticipated future demands. Construction of the plant, designed by Shell's own engineers, will be started immediately by Refinery Engineering Ltd., of Toronto.

In the summer of 1956, Shell disclosed plans to build a plant to produce both detergent and gasoline alkylates, and construction now is under way. Production of detergent alkylate will diversify further the interest of Shell in the petrochemical industry. Availability of alkylate for gasoline blending will contribute to the production of superior internal-combustion fuels. Engineering and construction on the dual-purpose alkylation plant is scheduled for completion near year-end. The plant is capable of producing 1,500 b/d of gasoline alkylate and 400 b/d of detergent alkylate. The feed for the production of high-octane gasoline alkylate will be refinery butane-butylenes. The detergent alkylate will be synthesized from benzene, and a special

Shell Oil Co. of Canada's gas and sulfur plants at Jumping Pound, Alberta.



The new synthetic ammonia plant belonging to Northwest Nitro-Chemicals Ltd. at Medicine Hat, Alberta.



A view of the process piping rack in early stages of completion at Montreal East plant of Carbide Chemicals Co. Division of Union Carbide Canada Ltd.

polymer prepared at Montreal from refinery propylene. The dual-purpose HF-alkylation plant contains many innovations and unusual features conceived by Shell's engineering group. The design contractor is Universal Oil Products Co. The contract for final engineering and construction was let to the Refinery Engineering Co. Ltd., Toronto. The estimated plant cost is $3 million.

Polyethylene production in Canada is growing at a highly satisfactory rate. In 1956, Canada consumed about 23 million pounds—an increase of 40% over 1955—and a further increase of about 35% is anticipated this year. By 1960, demand is estimated at 50 million pounds.

Principal supplier in Canada thus far is Canadian Industries Ltd., which built a $15 million plant at Edmonton in 1953—making its first shipments at the beginning of 1954. Ultimate design capacity of the plant is 50 million pounds per year; but initial planned capacity was 12 million pounds, which later was increased to 22.6 million pounds as market estimates were revised. Union Carbide Canada Ltd. has been producing various ethylene derivatives at Montreal since it took over the Dominion Tar and Chemical Co. plant at that point. The company now is building a polyethylene plant which will be in operation later this year. Dow is said to be also looking into polyethylene as an added item for its Sarnia works.

Canada has the capacity to produce 125,200 long tons of sulfur per year from natural gas. Shell Oil Co., at Jumping Pound, and Royalite Oil Co., at Turner Valley, were early producers. Shell now has a capacity of 28,800 long tons, following an expansion of its original 10,000-ton plant built in 1952. Big new plant built in 1956 was the 82,000-ton unit of British American Oil Co., in the Pincher Creek field.

On May 15, 1956, construction of the Pincher Creek sulfur plant was begun. By December 31, construction was approximately 90% completed. The ultimate project is designed to produce sulfur, LPG products, and condensate, and will be comprised of a gas-treating plant, a sulfur-recovery plant, gathering and injection lines between the plant site and the Pincher Creek field, and a dam across the nearby Drywood River; the latter is necessary to insure a continuous supply of water for steam and cooling purposes. The ultimate plant is designed to operate on a daily intake of 240 mmcf of raw gas.

The stage I plant, which is now complete and in operation, is designed to operate on a daily raw gas intake of 60 mmcf from three field wells and to produce 225 long tons of sulfur and 2,200 bbl of condensate daily. After processing, 43 mmcf of residue gas daily is to be returned to the field reservoir through an input well until contractual sales requirements to the Trans-Canada Pipe Line must be met. The stage I plant will be enlarged in time to meet gas sales to Trans-Canada Pipe Lines, beginning November 1, 1958. Sales will average 59 mmcf per day during the first year, and will reach 150 mmcf per day in approximately four years. It is estimated that the daily throughput of the enlarged plant will be nearly 800 long tons of sulfur, 1,200 bbl of propane, 1,200 bbl of butane, 875 bbl of natural gasoline, and 7,000 bbl of condensate. In order to handle product shipment, a 22-mile railroad spur was built from the main line at Brocket, Alberta, to the plant site by the Canadian Pacific Railroad.

Sulfur was first produced on February 1, 1957.

Gas from the Fort St. John area must be denuded of its sulfur before it can be delivered by Westcoast Transmission Co. to consumers in British Columbia and in the United States. For this purpose, Jefferson Lake Sulphur Co. is building a plant at Fort St. John, which will produce 108,000 tons per year—increasing Canadian capacity by about 80%. The plant will be in connection with a natural-gasoline plant and a joint operation with Pacific Petroleums.

Ammonia production, both from natural gas and oil, has been expanding in Canada as in other countries. In eastern Canada, Canadian Industries Ltd., of Millhaven, Ontario, completed an ammonia plant, based on fuel oil, late in 1956. It has a capacity of 67,000 tons per year. In Quebec, the Quebec Ammonia Co. Ltd. is planning a 43,800-ton plant based on fuel oil.

First Canadian production of ammonia was from natural gas, produced in the West by Consolidated Mining and Smelting Co. operating the Alberta Nitrogen Co. during World War II. The plant located at Calgary has a capacity of 130,000 tons of ammonia per year.

It began operations in 1941. The second ammonia plant based on natural gas was not built until 1954. It was erected by Sherritt Gordon Mines Ltd. to produce ammonia required in a metals' purification process. The ammonia section of the plant produced 3,500 tons of ammonia yearly and 75,000 tons of ammonium sulfate. Latest plant to become operative is the $22 million nitrogenous fertilizer plant of Northwest Nitrochemicals Ltd., at Medicine Hat, Alberta. Planned also for the West is a plant to be built at Winnipeg by Canadian Hydrocarbons Ltd., which may have a capacity of 29,200 tons per year of ammonia and 219,000 tons per year of nitrogenous fertilizer.

Northwest Nitro's plant includes facilities for the production of synthetic Ammonia, nitric acid, sulfuric acid, and ammonium nitrate. Northwest's plant was constructed in four of its six major units by the M. W. Kellogg Co., using the company's Steam Methane High Pressure Reforming process. The unit is designed to produce 100 tons of synthetic ammonia per stream day at a low investment cost per ton of annual capacity. Sulfur is obtained from the new Pincher Creek plant of Canadian Gulf Sulphur Co. Phosphate rock comes from Idaho. About 135 tons per day of sulfur will be used in full production, and about 135,000 tons of rock per year.

Polymer Corp. will build a $30 million chemical plant at Red Deer, in central Alberta, for butadiene manufacture.

Largest single petrochemical plant in Canada is the $80 million Canadian Chemical Co. Ltd. installation at Edmonton, which produces a wide variety of products from the oxidation of propane and butane. In addition to cellulose acetate, some of the main products are pentaerythriol, methanol, acetone, formaldehyde, propylene glycol, n-propyl acetate, acetic acid, and isobutanol. Production began in 1953.

Carbon blacks are produced in Canada by Cabot Carbon of Canada Ltd., at Sarnia, by the furnace-black method. Production is about 60 million pounds yearly. The plant was built in 1953 at cost of $4.5 million. END

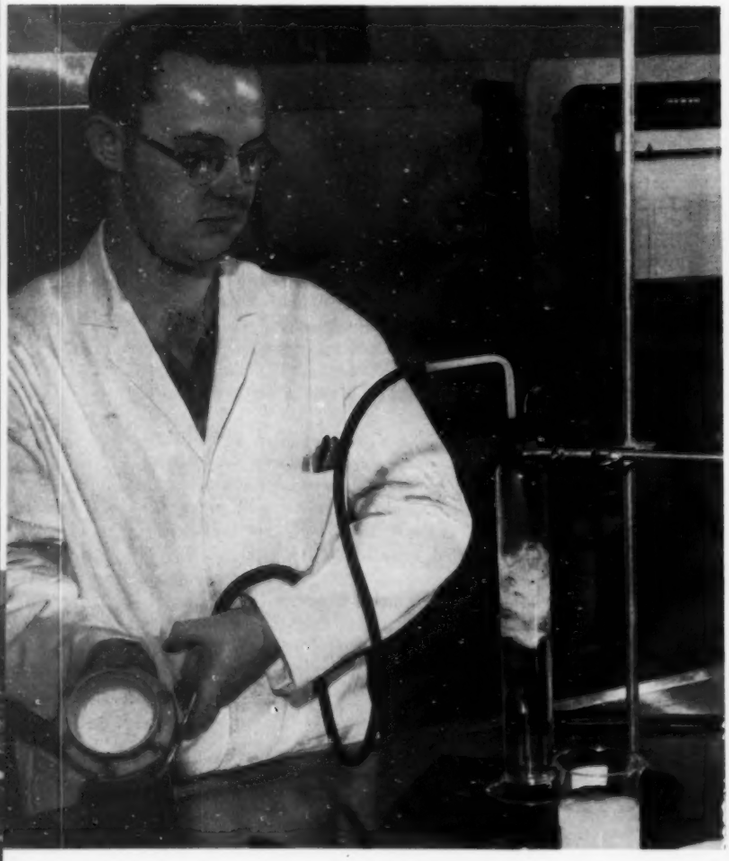
Development of a Process

IMPERIAL'S SARNIA WAX PLANT

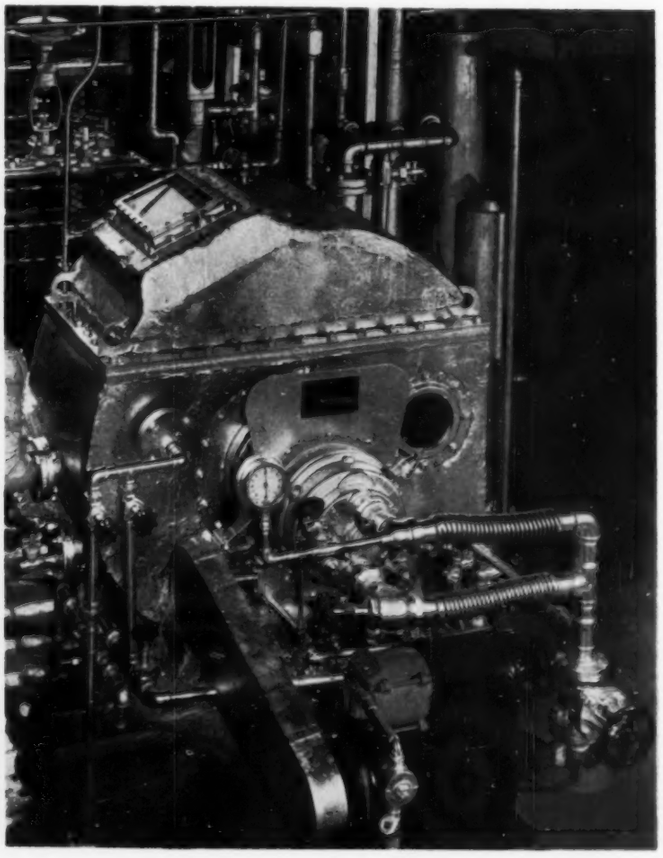
By C. B. Newbury

Recrystallization of slack wax is employed to produce microcrystalline waxes, at the recently completed 34-million-pound Sarnia wax plant, in a process on which development work had begun prior to World War II.

Research laboratory—the birthplace of the wax recrystallization process: Shown is a sample of wax being dried on a small laboratory filter.



Pilot unit: A 9.5-sq-ft rotary vacuum filter was used to produce wax samples for market evaluation and to develop new techniques.



RECOGNIZING the growing need for new and better-quality waxes in Canada, Imperial Oil Limited announced, in May 1955, a program to modernize its wax-producing facilities. The spring of this year marked the completion of this program with the coming onstream of the recrystallization, hydrofining, blending, slabbing, and packaging units. This new plant, which produces 34 million pounds per year of refined paraffin, microcrystalline, crude, and blended specialty waxes, is located at the largest of Imperial's refineries, in Sarnia, Ontario.

The manufacturing and marketing of petroleum waxes is not new to Imperial. As long ago as December 1897, advertisements in the Toronto *Globe* included "crude, semi-refined, refined waxes, and candles" along with other products offered for sale by Imperial.

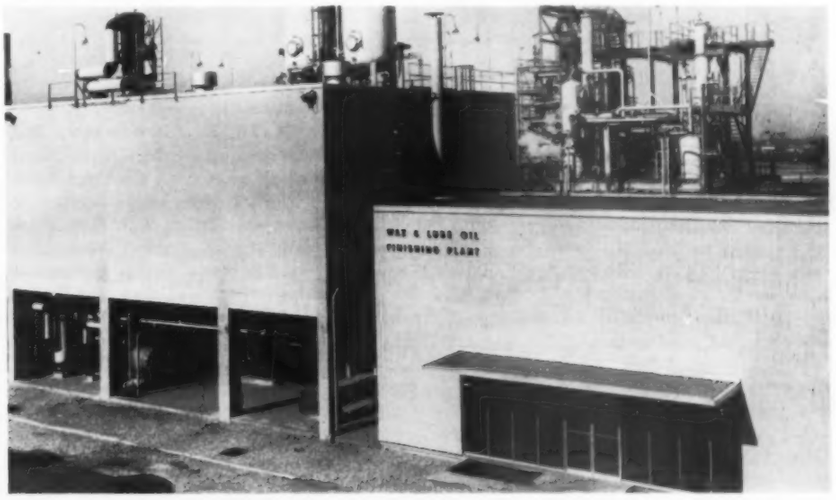
A twofold increase in the Canadian consumption of petroleum products has taken place in the decade since Imperial discovered oil at Leduc in western Canada. In the wax field, this increase has been coupled with a new look. As more is learned about the properties of finished waxes, it has been found necessary to incorporate special quality-controlled features into their manufacture. Waxes have changed from a commodity product sold by melting-point grades to a group of specialty products tailor-made for specific uses.

Although there are many kinds of waxes, those obtained from petroleum can be divided roughly into two groups—the paraffin waxes and the microcrystalline waxes. The most distinctive difference between the two groups is the size of the wax crystals formed upon solidification. Paraffin waxes are composed of relatively large crystals, while microcrystalline waxes are composed of exceedingly small crystals. At Sarnia, paraffin waxes are obtained in the solvent dewaxing of narrow-cut light lube-oil distillates, and microcrystalline waxes are obtained in the dewaxing of narrow-cut intermediate and heavy lube-oil distillates.

Before describing the recently built plant, it may be worthwhile to review some of the research and development work which led to the design and construction of the new facilities. Prior to 1938 Imperial's paraffin waxes were obtained by chilling light paraffin distillate to about 35 F and forcing the chilled distillate through plate and frame presses. The wax thus obtained was called "slack wax." It was a very limp material due to an oil content of 50% or more. These slack waxes were then separated by the sweating process. Cakes of wax were slowly warmed to a temperature such that oil and low-melting-point waxes became sufficiently fluid to seep through the spaces between the relatively large crystals of solid higher-melting-point waxes. In manufacturing various grades of refined wax, each with its particular melting point, the sweating operation had to be repeated many times.

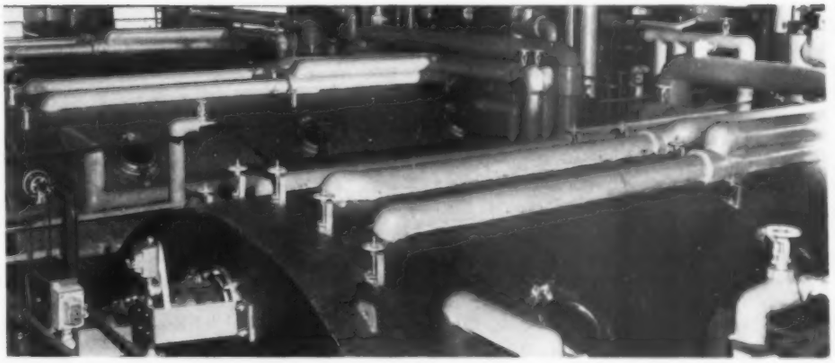
In 1938, as a result of extensive research and development work, solvent dewaxing was installed in Sarnia to supplant the cold-pressing and centrifuge processes for the dewaxing of all phenol-treated lube distillates. In the dewaxing unit, a mixture of ketone and waxy oil is chilled to the desired filtering temperature in refrigerated scraped-surface exchangers and chillers. The ketone keeps the oil in solution while

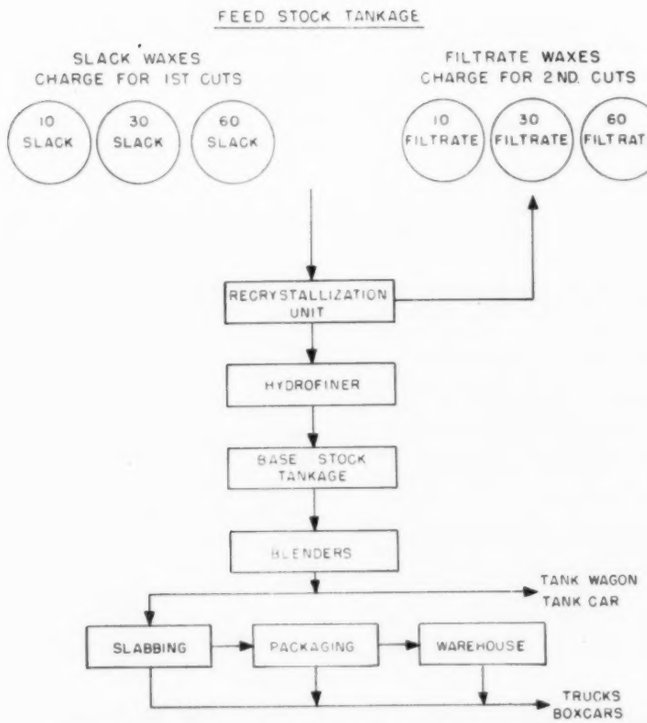
C. B. Newbury is a chemical engineering graduate of Manitoba and McGill Universities. Following experience gained in the laboratory and in refinery operations, he joined Imperial Oil Limited in 1951. As a process design engineer on the staff of Imperial's engineering division, he has been connected with projects involving the expansion and modernization of Imperial's refineries. Recently he has worked on the design and start-up of Edmonton's lube oil plant and Sarnia's wax plant.



The control room and filter building are shown in the foreground. The upper level of the solvent-recovery structure appears in the background.

Filter room in the new unit: The recrystallized wax is separated and de-oiled on the 400-sq-ft rotary vacuum filters shown in the photo.





Block diagram of flow through Imperial's modernized wax facilities.

the wax crystallizes out. Rotary vacuum filters are used to separate the wax from the filtrate, which is a solution of dewaxed oil and ketone. The wax cake, which is formed on the filter, contains ketone and a small amount of oil. The solvent-dewaxing process produces oils with low pour points. Furthermore, it is applicable to the dewaxing of light, intermediate, and heavy distillates. The processing of these heavier distillates yields crude microcrystalline-type waxes. Most other refiners still produce this type of crude wax as byproducts during the manufacture of bright stock.

With the successful operation of the solvent-dewaxing unit, Imperial's research chemists began investigating new processes to separate the slack waxes. By the fall of 1939, research work had progressed to the point where oil-free waxes of narrow-melting-point range were being produced in the laboratory by fractional crystallization and de-oiling of slack waxes in the presence of ketone. Studies were continued until 1940 when, because of war conditions, further development work on this project was abandoned temporarily.

In 1946 a small pilot plant employing a 3-ft-square rotary vacuum filter was built to study the properties of the recrystallized waxes and to permit production of 15-lb to 25-lb samples for customer evaluation. To obtain larger samples for market evaluation and to study process and quality factors needed to clarify the design basis for a large-scale unit, a semi-commercial recrystallization unit was constructed during the summer of 1950. Studies were conducted to explore various chilling, filter-washing, and drying techniques; the effect of dilution; and filter modifications. At the same time, laboratory studies were made comparing fractional recrystallization with distillation and sweating. These studies[3] concluded that fractional recrystallization gives good melting-point separation; that distillation becomes less effective as the boiling points increase; and that sweating becomes inoperable for the separation of high-boiling-point slack waxes. Thus, it was reconfirmed that recrystallization of Sarnia's slack waxes was the most effective process for separating the various types of molecular structure present in the crude wax.

Having developed the process from the laboratory stage to the pilot-plant stage, many engineering problems remained to be solved before a full-scale commercial unit could be built. Detailed comparisons were made to determine whether integration of the new wax-recrystallization unit with the solvent-dewaxing unit, and operating both units as one, was preferable to building a separate recrystallization unit designed for blocked operations. Some of the advantages for integration were lower investment, manpower, and other operating costs due to shared facilities (flue gas, ketone, dehydration, etc.); elimination of intermediate tankage; and better heat economy. However, the detailed comparison of the two cases disclosed that the disadvantages of an integrated unit far outweighed the advantages. The decision to build a separate unit also was influenced by the space available and the blocking of room required for any further expansion of the dewaxing unit. By divorcing the two units, it was possible to integrate to a higher degree the next processing operation, that of wax hydrofining.

Before detailed designs were commenced, studies determined that: two-stage, rather than single-stage, evaporation would be used to recover the ketone from the filtrate and recrystallized wax cakes; 600 psig steam reboilers would be used rather than fired heaters; a central refrigeration plant would be installed rather than having separate facilities for the various users throughout the plant; high-pressure steam turbines, rather than electric motors, would be used to drive the centrifugal refrigeration compressors; electronic transmitters and controllers would be used in place of the standard pneumatic system.

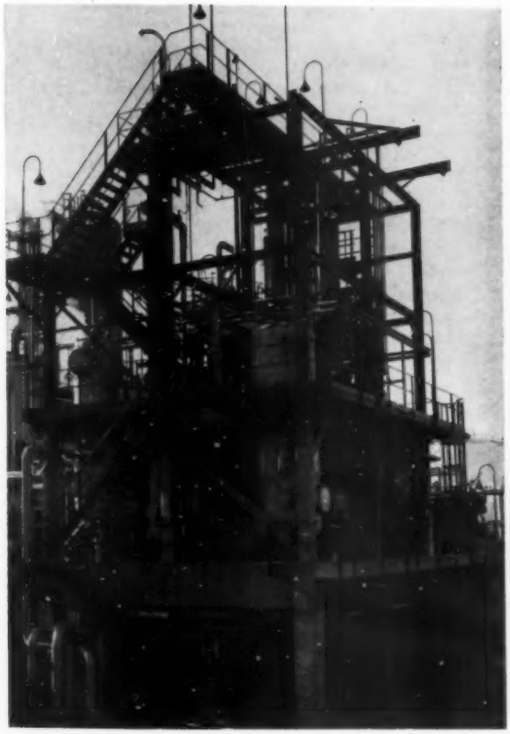
Several other unique features arising from operating know-how gained at the Sarnia and Edmonton dewaxing units were also incorporated into the design.

Having decided on the foregoing details, the next step was to select a site for the plant. Some of the points considered were whether: consolidation of lube- and wax-processing equipment into one area of the refinery was possible—this would permit short interconnecting piping between the units and permit utilization of common flue gas, refrigeration, and ketone storage tanks; the new facilities for blending, packaging, and shipping waxes could be located adjacent to the similar existing lube installations; extensive use could be made of existing buildings, tankage, and other equipment; the existing railway spurs and roads in the refinery could be used for the shipment of wax products.

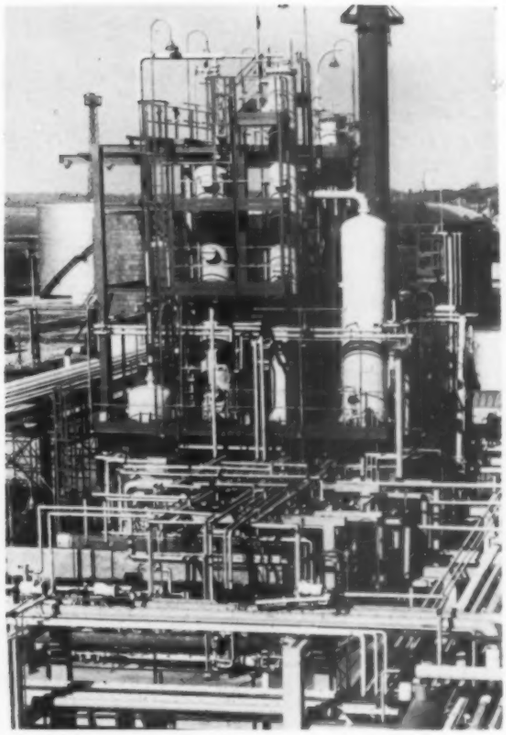
In addition to the foregoing points, consideration was given to the rather unique soil condition which exists in the Sarnia area. Starting from ground level, there is a crust of brown clay varying in thickness from 5 ft to 15 ft of relatively high-bearing capacity. Underlying the brown clay there is a thick stratum of blue clay (100 ft to 110 ft thick) of low-bearing capacity. For large structures or for structures built on land from which old footings have had to be removed, it has been found necessary to put piles down to bedrock or use large concrete floating rafts. The possibility of shear failure under heavily loaded structures and a certainty of extensive overall settlement preclude the use of standard spread footings. In this installation the filter building was floated on a large concrete raft (64 ft x 47 ft x 2.25 ft).

With the foregoing points in mind, a site was selected. Prior to drawing the detailed plot plans, models were used to determine the optimum layout for the process equipment.

As mentioned previously, the research work leading to the development of this process was for the most part carried out by Imperial's research department in Sarnia. The detailed process and general mechanical design was carried out by Imperial's



The wax-recovery tower, stripper, and surge drum are shown in the foreground on the roof of the open pumphouse.



Dehydrator filtrate stripper and two-stage evaporator tower of the azeotropic solvent-recovery section.

engineering division in Sarnia, with a resident engineer located at the site to aid the contractor during construction. The detailed mechanical design and construction was by Fluor Corp. of Canada, located in Niagara Falls, Canada.

In processing wax by solvent recrystallization, the slack wax obtained from the solvent dewaxing of phenol-treated distillates is first dissolved in hot solvent. The solution is then chilled sufficiently to precipitate the desired wax crystals, which are then recovered by filtration, washed, and de-oiled to give a wax of definite melting point. The recrystallized waxes are then hydrofined. As required, the finished waxes are blended and shipped. The procesing sequence is shown diagramatically in the accompanying diagram.

At the recrystallization unit, the slack wax and ketone are mixed and heated above the solubility temperature. The mixture is then cooled in a scraped-surface double-pipe exchanger using a cold-process stream as the cooling medium. A tube-and-shell scraped-surface chiller is used to chill the feed to the filtering temperature, using ammonia refrigeration. The refrigeration system, integrated with other parts of the plant, consists of two freon-ammonia cascade centrifugal compressor units, each capable of 350 tons of refrigeration. The ammonia refrigerant is pumped to the users at −25 F. The chilled slurry composed of solid wax, ketone and liquid wax is filtered and de-oiled on three 400-sq-ft rotary vacuum filters. These filters, constructed to Imperial's requirements, are of special design to permit use of newly developed filtering, wash and drying techniques. Recovery of the solvent from the filtrate is accomplished by two-stage evaporation followed by steam stripping. The stripped filtrate wax from a first-cut operation is sent to tankage, and serves as feed stock for subsequent production of second-cut waxes. The recrystallized wax cakes, after ketone removal, are processed directly through the hydrofiner. Azeotropic distillation is employed to keep the water content of the circulating ketone solvent to a low level.

The hydrofining process developed by Imperial is used to improve color and odor of recrystallized waxes. Hydrogen and wax are passed at elevated temperature and pressure over a modified molybdenum-on-alumina catalyst. To maintain catalyst activity and to ensure satisfactory color, two reactors are used—one reactor for light waxes and the other for dark waxes. The hydrofined wax is stored in finished base tanks, the temperature of which is automatically controlled.

Four blenders, each equipped with electric mixers, are used to batch-blend the base waxes and to mix in any inhibitors or additives which may be required. For solid shipments, wax is slabbed in two continuous automatic slabbing machines in conjunction with automatic packaging facilities. Liquid wax is deposited at a uniform weight into traveling pans. The pans, six abreast on a continuous conveyor, travel through a cooling chamber where circulating cold air cools and solidifies the wax. As the pans emerge from the top of the cooling chamber, they are inverted and pass over depanning rollers. The wax slabs are deposited onto a side discharge conveyor which delivers them to the automatic packaging equipment or to a bulk loading station. Fork-lift trucks are used to move the pallets of wax slabs and cartons from the packaging machines to the warehouse or to box cars and truck transports. For liquid shipments, the blended wax is pumped directly from the blenders to tank cars or tank wagons.

Recrystallized waxes are used for a multiplicity of purposes. Some are used to coat milk cartons, bread wrappings, household papers, and various other types of food containers; while others find use in agricultural, industrial, and medical processes.

The development of the wax-recrystallization process culminates many years of research, product development, and engineering on the part of Imperial's research, marketing, and manufacturing departments.

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Exploratory wells are down 20% and development drilling down 28% in Manitoba. The Virden-Roselea field is growing slightly, but the other principal field, Daly, is declining. A major marketing switch put Manitoba crude into the Great Northern Co., in St. Paul, Minn.

MANITOBA is still looking for a good discovery which can be offset on all four sides without a dry hole and which will not go to water within the first month. Hopes are still high, but exploratory effort declined for the second consecutive year in 1956. It increased slightly so far in 1957, but without discoveries.

A long drought in oil finding struck Manitoba in 1956, in sharp contrast to the spectacular discovery year experienced in 1955. The impact of the slack was felt more in development completions than in wildcats, as fields discovered in previous years reached a near maturity in drilling out and no new pools were found to take their place.

It was the second successive year for a substantial decline in wildcats—44 exploratory wells were drilled, compared to 54 in 1955. The 1955 wildcats yielded 10 oil discoveries, while 1956 operations resulted in only one lone oil strike. As this well was still a single marginal producer at the end of the year, with no development drilling projected, the year could not be considered encouraging. In spite of the disappointment, there were several large sales of both permit and lease acreage at Crown reserve auctions during 1956; and the commitment wells on these parcels, some of which were drilled in 1956, will keep wildcat activity at a fairly good level in 1957. In fact, the indications from the first two months of the current year are that wildcat drilling will be more extensive than in 1956.

Development drilling was down more than wildcatting in 1956, as 218 wells were completed—down 28% from the 305 drilled in 1955. The success ratio was much higher. Oil wells were 201, or 92%; only 9 were dry, and 8 were completed as salt water-disposal or water-injection wells. In 1955 there were 271 oil wells, but 24 dry holes; 10 wells were drilled for salt-water disposal or water injection.

The total of 262 well completions for Manitoba in 1956 was off by 97 completions, or 27% from the 259 wells drilled in 1955. Footage drilled was down a little more in proportion, as the average depth of wells was moderately shallower with fewer wildcats and a slight decrease in development-

MANITOBA STILL HOPING

well depth as operations moved up-dip in both Virden-Roselea and North Virden. The 1956 total of 611,503 ft was down 28% from the 1955 total of 847,656 ft.

Noticeably absent from the ranks of the wildcatters were two big teams which drilled a large number of exploratory wells in 1955. McCarty & Coleman completed its program in 1955 and withdrew completely from Manitoba. Anglo-Canadian Oil Co. Ltd., and its subsidiary Souris Valley Oil Co. Ltd., completed their program in the extreme southeast corner and were completely inactive last year.

Canadian Superior Oil of California Ltd., out of the wildcat picture in 1955, returned in 1956 with one of the largest programs, involving 5 wells. Dome Exploration (Western) Limited, continuing active, drilled eight wildcats. Imperial Oil Ltd. and Canadian Prospect Ltd. put down five each, and Amerada Petroleum Corp., a new entrant in 1956, drilled four.

The single discovery was made by Imperial and The California Standard Co. in an extension wildcat, two miles northeast of the Waskada pool but separated from it by a dry hole. The well is Imperial-Cal Standard Hernefield 1-30-1-25, 1sd 1-30-1-25WPM, KB, 1,551 ft, which finished drilling on July 29, 1956, at total depth of 4,300 ft (2,749 ft subsea) and plugged back to 3,900 ft before setting production casing at 3,220 ft below the bottom of the indicated pay zone in the Mission Canyon member of Mississippian limestone. The top was logged at 3,005 ft and 12 ft of net pay of 35 API gravity oil reported. Actual production results were not encouraging. The well was suspended in the fall after producing almost equal quantities of oil and water. Cumulative production to the year end was 2,218 bbl of oil and 2,244 bbl of salt water.

This experience has been duplicated in most minor fields. The year's operations accentuated the importance in Manitoba oil production of the three principal fields: Daly, Virden-Roselea, and North Virden. They accounted for 90% of all production, and had the least trouble with water intrusion, on the average. Most minor fields and pools suffered from watering-up problems by the end of 1956. Several wells in these fields were shut in because they had become uneconomic and the current producing rate did not justify installation of salt-water disposal facilities.

Crude-oil production for 1956 was 5,786,540 bbl, an average of 15,810 b/d. Although the year's production was up 1,640,784 bbl (40%) over 1955 total of 4,145,756 bbl, the variation from the lowest to the highest month was not so wide as this average increase. The year started on a fairly high level, with January production averaging 14,017 b/d, and rose steadily to 17,311 b/d in September, with the exception of the normal seasonal slump in April due to spring breakup and road bans. In the last quarter there was a slight but steady decline in each successive month, down to an average of 15,987 b/d in December.

The rather peculiar fluctuation of production in relation to well completions was caused by the impact of decline curves on older wells. This became more apparent in the second half of the year. During the first half the effect of the high completion rate of 1956 was still being felt. In the second half, however, even the completion of 131 new development oil wells was not sufficient to offset it. At the end of December there were 736 wells capable of producing oil, in contrast to 554 producers at the end of 1955. Wells actually producing numbered 646 last December. In December 1955 there were 470, so that average production declined from about 30 b/d to not quite 25 b/d during 1956.

The North Virden field, latest of the three major fields to be discovered, produced 2,184,462 bbl. It took top place in 1956, with an average of almost 6,000 b/d. Virden-Roselea, second to be discovered, was in second place with 1,787,174 bbl, or just under 4,900 b/d. The aging Daly field, discovered in 1951 as the first commercial oil in Manitoba, produced 1,222,398 bbl last year for an average of a little better than 3,300 b/d.

These three fields, with their total of 5,194,034 bbl, accounted for 90% of the provincial total. Their significance increased throughout the year. In January they produced 382,578 bbl out of a provincial total of 434,521 bbl, or 88%. By December they were producing 459,115 out of 495,642 bbl, or 92½%.

The changing relationship of the three fields among themselves was a feature of 1956. The Daly field, almost fully developed, sank from January production of 101,316 bbl to a December production of 86,450 bbl. The Virden-Roselea field, discovered in 1953, and enjoying the highest development rate in 1956, gained from 125,112 bbl in January to 177,358 bbl in December. North Virden, nearing the limits of its indicated potential development, had a smaller rate of gain, although it produced at a higher level, as its January production of 156,150 bbl rose to 195,307 bbl in December.

Relative well completions among the fields showed the reason for the trend. There are 109 new oil wells added to the Virden-Roselea field in 1956: 50 to North Virden and only 24 to Daly. At the end of the year there were 203 wells capable of producing in the Daly field: 267 in Virden-Roselea and 176 in North Virden. Actually producing in the last month of the year were 178 Daly wells: 227 in Virden-Roselea and 167 in North Virden.

The spread of exploratory drilling beyond the area known to be underlain by Mississippian sediments was very noticeable in 1956. Of the 44 wildcats drilled, 19, or nearly half, were put down east of the Mississippian truncation line. This line has been fairly closely defined by wildcat drilling which has taken place since the assumed location was first demonstrated by John R. Ower of The California Standard Co. in 1952. It trends in a southeasterly direction from the Saskatchewan border at a point parallel with Riding Mountain National Park to the North Dakota border just east of Turtle Mountain. Lower Cretaceous or Jurassic oil would be the objective of this wildcatting in most cases—although some deeper wells were drilled in 1956 in search of possible Devonian, Silurian, or Ordovician production. No indications of commercial production, however, resulted from any of this drilling.

Diversification of exploratory drilling was in marked contrast to both 1954 and 1955, when eight and six wildcats, respectively, were drilled outside the Mississippian area. The great bulk of this drilling was promoted by the fact that exploration reservations had been taken up by late arrivals to the Manitoba scene, after Mississippian area leases and reservations had been pretty well fully occupied, rather than from any geological opinion that the Mississippian is not still the most promising search objective. Conversely, any commercial discovery in another formation than the Lodgepole or Mission Canyon member of Mississippian would spark a major play for the remaining unoccupied oil leases and reservations in the large territory between Brandon and Winnipeg, north from the international border as far as the interlake region.

The year started well with a large-valued Crown reserve sale of exploration permits and a lease block on January 26. A second major sale was held on August 15. The first sale resulted in the acquisition by Shell Oil Co. of its first big exploration permit in Manitoba. For a cash bonus bid of $52,005, Shell bought the right to explore Crown rights in 59 townships, containing a total of 342,652 available acres. A work commitment of $100,000 within the first year was attached to the permit, which covered rights in the west flank of the province, partly within but mostly beyond the Mississippian area. Starting in June, Shell conducted an extensive and widely checkerboarded campaign of core-hole drilling on its reservation. By suspension of drilling activities in the late fall, Shell had completed 14 core holes for a total footage of over 25,000 ft. All results were kept confidential, and Shell has not yet announced whether it has plans for full-diameter wildcat drilling in 1957.

Photo courtesy of Royalite Oil Co.

The California Standard Co., pioneer exploration permit holder in the province, took up a large block of 191,376 acres, comprising all the Crown rights in 9½ townships within a concentrated area west and north of the Shell block, west of Riding Mountain Park. The work commitment was $20,000 and the cash bonus bid $1,914. No wildcat drilling was done on the parcel during 1956.

A lease block bought by Canadian Prospect Ltd. for cash bonus of $4,043 contains 7,685 acres in the Spruce Woods Forest Reserve. A commitment basement test was drilled to total depth of 2,765 ft almost immediately, in March, and was completed as a dry hole. No more drilling has taken place.

A Dominion government lease sale of 3,760 acres in the southwestern sector on April 23 was dominated by The British American Oil Co. Ltd. B-A bought 3,600 acres for a cash bonus of $4,041. Imperial Oil Ltd. took the other 160 acres for $640. Rights are all east of Turtle Mountain in the first three townships north of the international boundary. Very little drilling has been done in the vicinity. It represents one of the more promising regions close to the Mississippian truncation line. No wildcat wells were drilled, however, in 1956 by either of the purchasers.

The second major provincial sale was held on August 15, and returned $91,768 for one exploration reservation and 14 lease blocks. The reservation, comprising 95,680 acres in the non-Mississippian area southeast of Brandon, was bought by Amerada Petroleum Corp. for a cash bonus of $51,917, in competition with four other bidders. The single commitment well required within one year under the terms of the sale has not yet been drilled.

The lease blocks went principally to The California Standard Co., which bought six parcels for a total cash bonus of $18,941. Shell Oil Co. paid $18,310 cash bonus for another six parcels. No drilling was done on these purchases during 1956. A program is expected for 1957 on the part of both companies.

A new entrant into Manitoba, Sohio Petroleum Co., bought the remaining two leases for cash bonuses amounting to $2,400.

Promise of a more active wildcat year in 1957 was contained in the completion of eight exploratory wells in the first six weeks and the starting of four more wildcat drillers in early February. This pace of operations stood out in contrast to the completion of only seven wildcats in the first two full months of 1956. Development wells were drilled at a slightly greater rate in January—with 22 completions—than in January a year ago, when 19 were completed. The outlook for 1957 is very difficult to forecast. A fair assumption would be for a total of some 200 wells as a minimum, of which nearly half would be wildcats. Depending on the discovery rate, this minimum could be expanded to 300 or more if a substantial oil pool were to be discovered early enough in the year.

Crude-oil production appears headed for a steady pace through 1957, unless another substantial pool is discovered. The effect of the high autumn and winter completion rate should offset the gradual decline in production from the older wells in the three principal fields. All the wells in minor fields, and the production average, should be sustained at upwards of 15,000 b/d for a possible total of 6,000,000 bbl or slightly more than in 1956. Any major new pool discovery reasonably early in the year would, of course, stimulate enough development to raise this figure considerably.

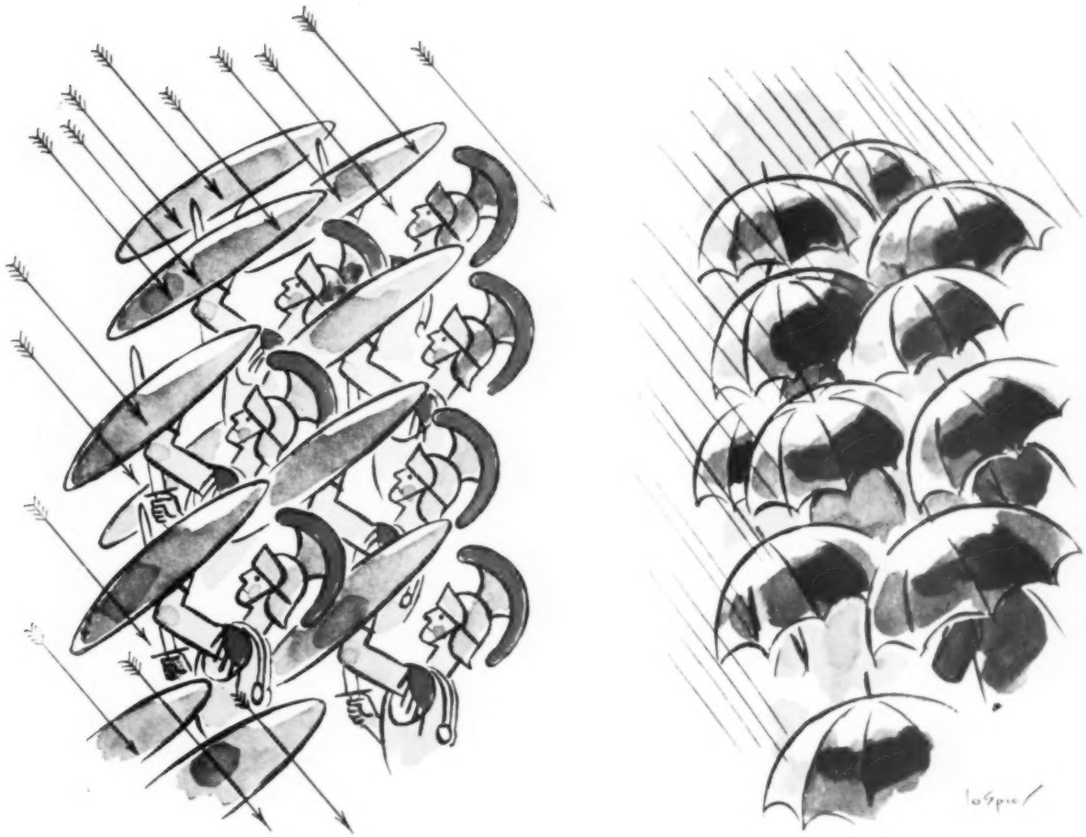
Enlargement of the gathering system of Trans-Prairie Pipelines Ltd., which serves the tri-field area, kept pace with well completions up to the end of the construction season. It permitted the movement of most crude by pipeline until December. Owing to the interruption caused by winter weather, wells completed through the winter have to wait until early summer for pipeline connections. The same weather conditions make tank truck pickups subject to delays. This is a normal factor in reducing Manitoba production during the mid-winter months, and widening the gap between wells capable of producing and those actually on production.

A major switch of markets for Manitoba crude occurred in the early months of 1957. The bulk of the production was bought by Great Northern Oil Purchasing Co. from Imperial Oil Ltd. (at the rate of 14,000 b/d in February) for ultimate delivery to the refinery of its parent, Great Northern Co., in St. Paul, Minn. Alignment of markets with production has become a little complicated. Saskatchewan crude is used mainly in the Winnipeg refineries now, with a small proportion of Alberta crude, all of light gravity. Manitoba crude thus does not actually supply the refineries in its own province.

On balance, Manitoba production is still only a little better than half the equivalent of local refining requirements. Both the Imperial and North Star Oil Ltd. refineries in the Winnipeg area have run over their rated capacities of 13,000 b/d and 12,000 b/d, respectively. The Brandon refinery of Anglo-Canadian Oils Ltd. has a steady run of 3,200 b/d, its rated capacity.

No enlargements were made to any of the Manitoba refineries in 1956. Towards the end of the year a contract for a major addition to the Imperial plant was awarded to Foster-Wheeler Ltd. This work involves the construction of a new powerformer, using platinum catalyst, along with auxiliary units consisting of a prefractionator and a hydrofiner, new boiler, piping, tanks, and utilities. Its capacity will be 3,000 b/d. In addition, crude processing units will be enlarged to increase rated capacity to 17,500 b/d in order to handle increased demand for products which has grown at a very satisfactory rate. The work was under way in the spring, with scheduled fall completion date.

A major accomplishment in transportation facilities crossing Manitoba was completed in 1956, with the loop of a remaining bottleneck section of the Interprovincial Pipe Line Co. main crude-oil pipeline. Laid in record time in the early summer, this 67-mile 24-in. loop brings the central Manitoba section of the line into balance with the sections on both sides of it. It permits full-capacity deliveries out of the Saskatchewan pipeline systems. END



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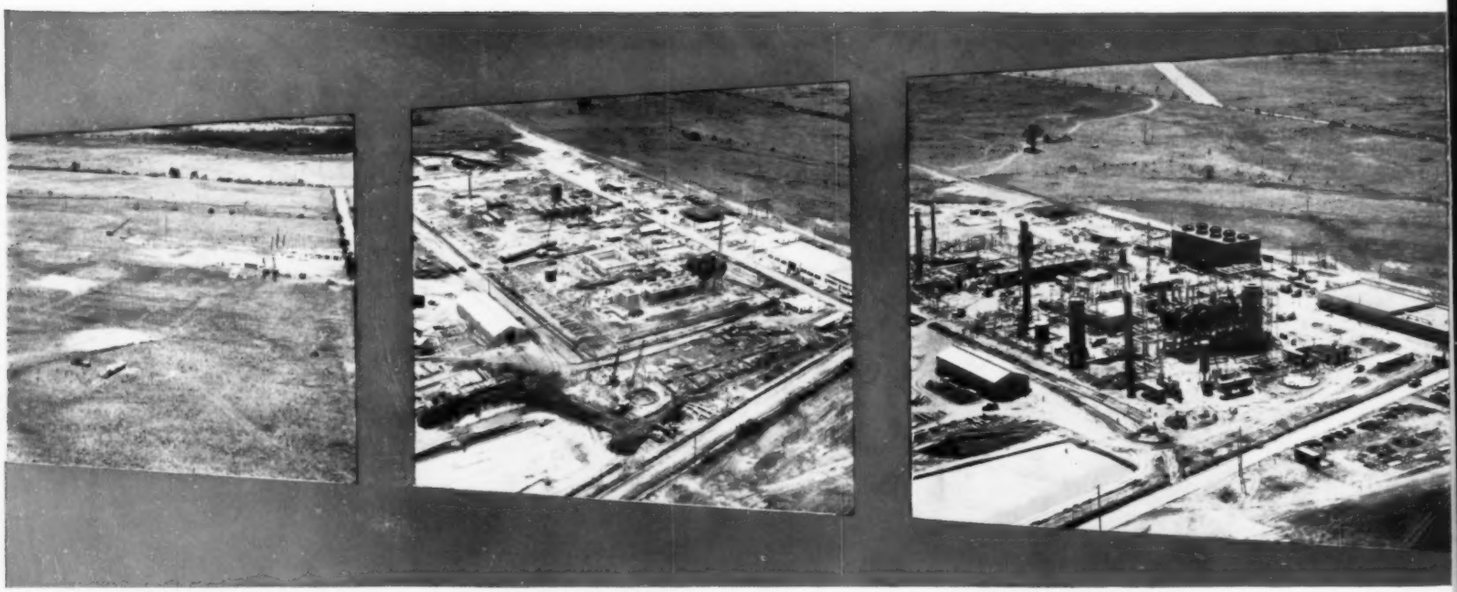

JUNE 26, 1956 AUGUST 28, 1956 OCTOBER 30, 1956

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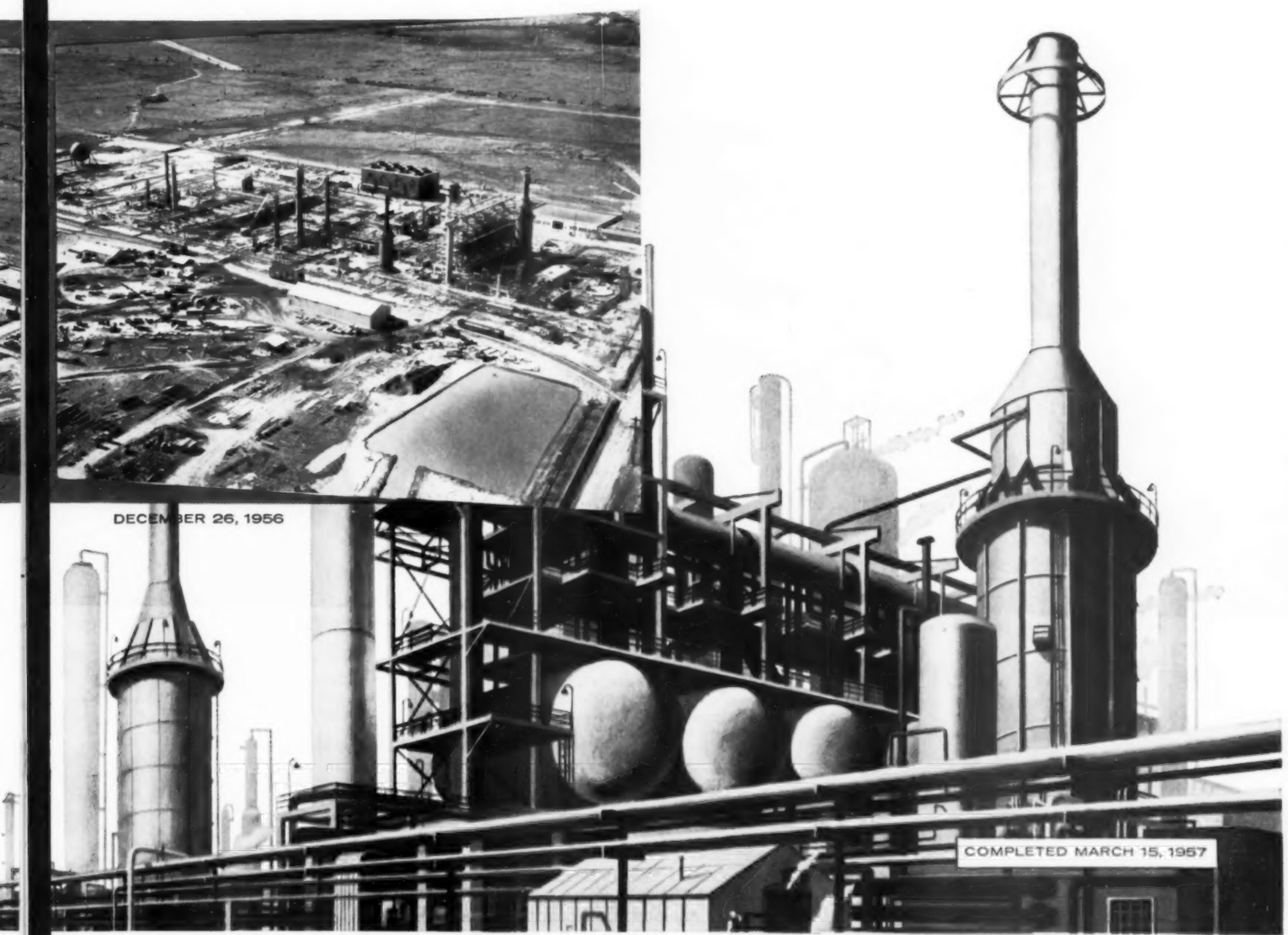
This outstanding performance clearly demonstrates the worth of undivided responsibility which enabled CATALYTIC to complete process design, engineering, procurement and construction of this multimillion dollar facility . . . on time and on budget.



"Neither snow nor rain nor heat nor gloom of night stays these couriers from the swift completion of their appointed rounds"--inscription, New York General Post Office

NEITHER SNOW NOR RAIN...

Northern snow and rain were taken in stride by these pipeline crews. As a result, homes and industries in Western Canada are assured earlier operation of a fuel supply system that is also "bigger than weather" . . . the Westcoast Transmission Company's 30-inch natural gas pipeline. The 700-mile system, reaching from Peace River to the international border, will be completed this fall.

The Westcoast pipeline is another major project engineered and constructed under Bechtel management.

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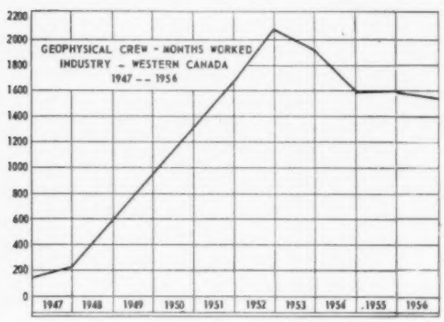
Builders for Industry

GEOPHYSICAL ACTIVITY DOWN IN WESTERN CANADA 1956

Shell Oil Co. recently conducted a series of northern trials with the R. G. LeTourneau electric transporter shown operated electrically by individual motors in each of the six wheels. In addition, all components are all-electric. The power source is an AC-DC generator, driven by a 300-hp turbo-charge diesel engine which burns regular diesel fuel.

Geophysical activity in Canada seems stuck on the low plateau it reached in 1954. During 1956 total party-hours declined about 1% to 1,484. The decline was sharpest in gravity work, down 23%. Of all the provinces, British Colombia suffered the greatest decline in overall activity. Saskatchewan was the only province showing a greater number of party-hours.



GEOPHYSICAL activity in western Canada declined slightly during 1956 to remain at approximately 1950 levels. Party-months totaled 1,484 during the year—a decline for about 1% from 1955.

Of the types of partys used—seismic, gravity, and magnetometer—seismic party-months declined least during 1956. They fell to 1,397 in 1956 from 1,495 ½ during 1955—a decline of 6.6%. The largest absolute decline was in Alberta, where activity fell by 42½ seismic party-months, or about 4%. Saskatchewan declined by only 5½ party-months to 275 hours; Manitoba declined by two, to 22. A large relative decline was shown in British Columbia, which declined by 23% to 136 party-months. The Northwest Territories fell by more than half, to 13 party-months from 30 in 1955.

Gravity work declined most during the year. For western Canada as a whole, there was a decline of 18%, to 87 party-months in 1956. Alberta gravity work declined by 38% during the year, to only 60 hours during 1956. Saskatchewan rose to 24 hours during 1956, an increase of about 75%. Manitoba dropped to one gravity party-month in 1956 from three in 1955; British Columbia dropped to zero in 1956 from three in 1955; and the Northwest Territories gained two, from zero.

Magnetometer work has not been used during the past two years in any of the Prairie Provinces.

The usual seasonal fluctuation in geophysical activity was shown during the year. Beginning at the low point of April, when the "Road Closed" signs began to appear and the freeze went out of the muskeg, activity continued low until November. Typical of western Canada, which is in the odd position of having to do its heaviest work in the worst possible weather, activity continued low until November. Then it hit its beginning rise. The months of November, December, January, February, and March were the high points—nearly twice April levels. This was the same pattern followed in 1955. END

TABLE 1

1956 Geophysical Activity—Crew-Months—Western Canada*

	SEISMIC			GRAVITY			MAGNETOMETER			TOTAL		
	1956	1955	1947	1956	1955	1947	1956	1955	1947	1956	1955	1947
Alberta	951	993½	155	60	83	41	—	—	7	1,011	1,076½	203
Saskatchewan	275	280½	—	24	14	—	—	—	—	299	294½	—
Manitoba	22	24	6	1	3	—	—	—	—	23	27	6
British Columbia	136	167½	—	—	3	—	—	—	—	136	170½	—
NW Territory	13	30	—	2	—	—	—	—	—	15	30	—
Total	1,397	1,495½	161	87	103	41	—	—	7	1,484	1,598½	209

*Source: Crew-months data for this tabulation and Tables 1 and 2 were obtained from the Committee on Geophysical Activity of the Society of Exploration Geophysicists; Homer G. Patrick, chairman. The chart is reproduced through the courtesy of the editors of Geophysics for previous years, with 1956 added.

TABLE 2

Average Number of Crews—1956—Western Canada*

	SEISMIC	GRAVITY	MAG-NETOMETER	TOTAL
January	149	8	—	157
February	150	5	—	155
March	147	5	—	152
April	89	2	—	91
May	109	3	—	112
June	107	5	—	112
July	110	4	—	114
August	107	6	—	113
September	114	8	—	122
October	108	5	—	113
November	116	5	—	121
December	117	5	—	122
Total	142.3	61	—	1,484

*See footnote, Table 1.

SASKATCHEWAN ACTIVE in 1956

By R. R. McDaniel

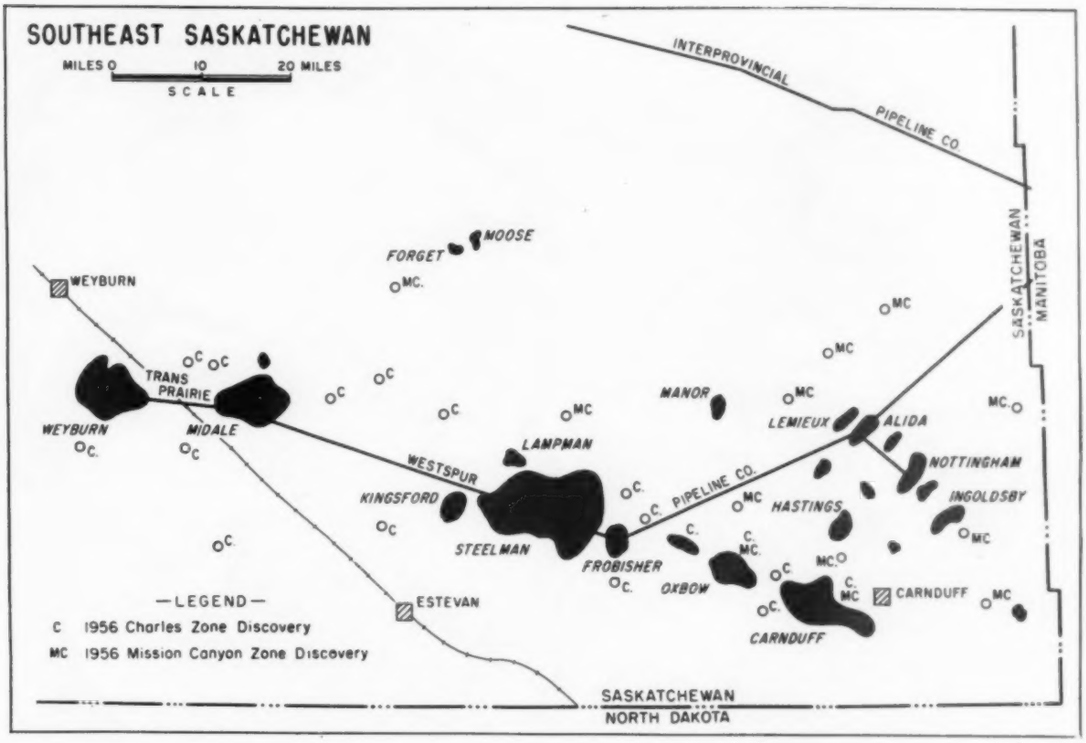
An increase in production to over 80,000 b/d, with record drilling activity, has brought Saskatchewan to a peak in oil activity during 1956. Several secondary-recovery projects are under way, including a major water flood of the Dollard field.

DURING 1956 the oil industry in the province of Saskatchewan experienced a very active year. Drilling activity reached a new high of over 600,000 ft per month. Crude-oil production set a new average daily record of over 80,000 b/d in December (see chart). A considerable portion of the province's crude-oil requirements, in the past, have been obtained from Alberta. Although the geographical location of Saskatchewan's major crude-oil producing areas are such that this requirement will probably continue, it is now evident that the province is a net exporter of crude oil. The major portion of the increase in crude production has been in light-gravity oils. Production of crudes with a gravity of over 30 deg API has increased from an average of 11,500 b/d in December 1955 to 37,000 b/d in December 1956. The majority of the increased activity and production has occurred in the southeastern portion of the province. The main development in this area has been along the Mississippian Charles trend, including fields such as Weyburn, Midale, Steelman-Kingsford, Oxbow, and Florence-Carnduff (see map). The Westspur Pipe Line Co. system now services a large portion of this area. Trans-Prairie Pipe Line Co. is presently constructing a line from Midale to the Weyburn field. The majority of production in question, as a result, is tied into major pipeline systems and, consequently, can be marketed readily.

R. R. McDaniel, consulting petroleum engineer at Calgary, is a native of Canada. He has been engaged in oil engineering since his graduation in 1947 by the University of Oklahoma. Before his transfer to the Imperial Oil Ltd. staff at Calgary, he had been with Creole Petroleum Corp. in production and reservoir engineering at Maracaibo, Venezuela. He resigned from Imperial as division reservoir engineer to organize McDaniel Consultants Ltd.

Development has also continued in the general Coleville area of northwestern Saskatchewan. The heavy crude-oil production from this field has increased from around 4,400 b/d in December 1955 to over 5,800 b/d in December 1956. In the southwestern portion of the province, water flooding has become of major importance. Several such projects either are being initiated or are under consideration. The largest of these schemes is being carried out in the Dollard field. Some 5,200 b/d of water were injected into that reservoir during December. Since this project was commenced, oil production has risen to 5,200 b/d from some 800 b/d. Other such projects in similar type fields in that area no doubt will increase production from that part of the province. It is also of importance to note that a crude-oil price increase of around 38 cents per barrel for this medium-gravity oil was obtained during the past 12 months. As a result, the general economics of developing and producing the fields in this area has improved considerably.

A wide program of gas distribution presently is being effected by the Saskatchewan Power Corp. During 1956 an active program of connecting local fields to the principal centers was carried out. It is anticipated that a large portion of the province will be served by natural gas within the near future. It has been reported that gas will be obtained both from local fields and from Trans-Canada Pipelines Ltd. to supply these markets. It is of interest to note that sub-



stantial gas reserves have been found in the southeastern portion of the province. This gas exists in the form of gas caps and as dissolved gas in the oil reservoirs in that area. Although such gas would have to be processed before it could be marketed, substantial production, nevertheless, may be anticipated.

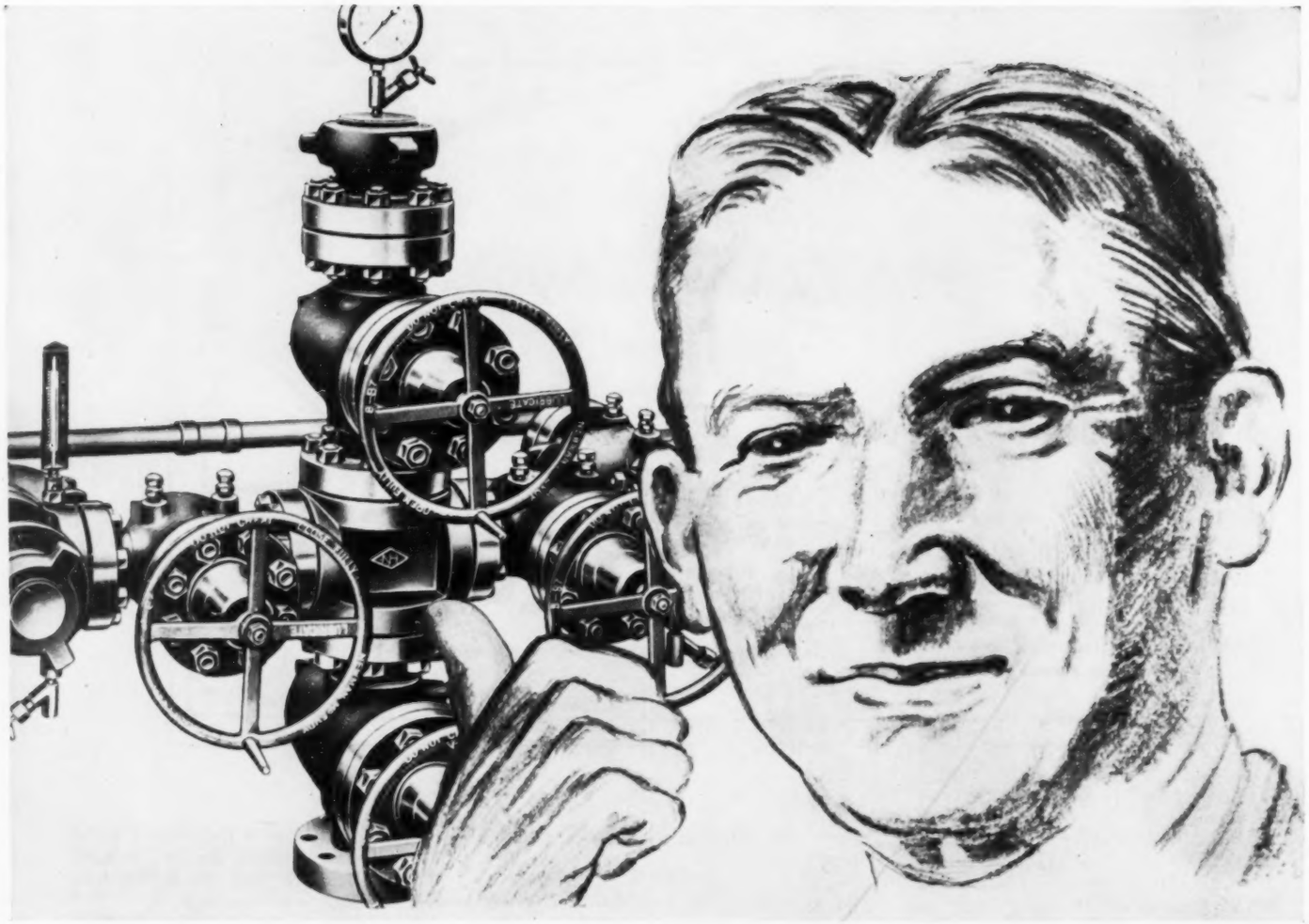
In view of the greatly increased activity and production in the southeastern portion of the province, this area has been reviewed in more detail. A high discovery ratio was again evident in the area during 1956. Fields such as Florence-Carnduff and Oxbow, which were discovered during 1956, appear to be of appreciable size. Important extensions were made to the Weyburn field, and it now also appears to be one of the largest fields in the province. The majority of development in this area has been along the Charles trend. It is now apparent that a highly prolific trend of production exists from the Weyburn field in the western portion of the area to the Carnduff field in the eastern portion. The discoveries made during 1956 along this trend are shown in the map accompanying this article. It will be noted that there have been approximately 20 such discoveries, a number of which may be indicative of sizeable fields. Also, it became evident during 1956 that several Charles formation trends occur throughout the area. The Midale zone, which is the principal producing horizon in the Charles formation, appears to be of a highly stratigraphic nature. It originally was believed that oil accumulations would be more or less limited to a narrow band somewhat downdip from the pinchout edge of the zone. It is, however, now evident that production may be found both in the deeper portions of the basin and on the erosional edge of the zone.

The Mission Canyon formation is found immediately beneath the Charles formation. This formation subcrops directly north of the Charles trend. Production usually is obtained in erosional-type features which occur in this subcrop area. The Mission Canyon zone is also found productive beneath the Charles zone in several areas; however, the production has not been found to be of an appreciable nature to date. The majority of Mission Canyon zone production has been encountered in the Alida-Nottingham area. Although production from this area has increased during the past year, it has not grown so rapidly as originally had been anticipated. Development of edge-type locations has been at a slow pace. Although a number of new discoveries have been made in the Mission Canyon, only the more prolific pools have been drilled actively. The fact that this area was discovered several years ago and has been explored actively since, may have some bearing on this condition; however, production problems appear to be the most deterring factor. The Mission Canyon horizon is a thick water-bearing formation. Therefore, it is believed that a strong water drive will be found to exist in most of these reservoirs. Although this mechanism will probably aid recoveries in those fields with thick pay-zone sections, water coning has become a severe problem in the wells with thinner pay sections. Unless a technique is found by which this condition can be alleviated, the economics of fully developing such reservoirs may not be realistic.

There were several significant new Mission Canyon discoveries in this area during 1956. The most important of these are believed to be the North Nottingham pool, which is situated immediately between the Alida and Nottingham fields; the Gainsborough pool, which is situated south and east of the Alida-Nottingham area; and the Queensdale and Manor pools, which are located north and west of the main area. The fact that these fields are found at a relatively shallow depth of from 3,500 ft to 3,800 ft provides for excellent economics if clean producing wells are obtained. It is believed that, through improved completion techniques, it should be possible at least partly to control the water-breakthrough problem. It is also evident that, in view of the number of discoveries in this horizon during the past year, the prospects of finding more fields would appear to be very good.

In view of the importance of the southeast Saskatchewan area, a review of the larger fields has been prepared. The pertinent data for each field are summarized in the accompanying table.

Weyburn Field: The Weyburn field is situated at the western end of the presently known Charles trend. Production is obtained from the Midale zone, which is found in the lower portions of the Charles formation. During the latter part of 1956 a number of step out wells were drilled in



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Early American Oil Man

The American Indian is credited with many firsts, to which should be added the discovery of oil in America.

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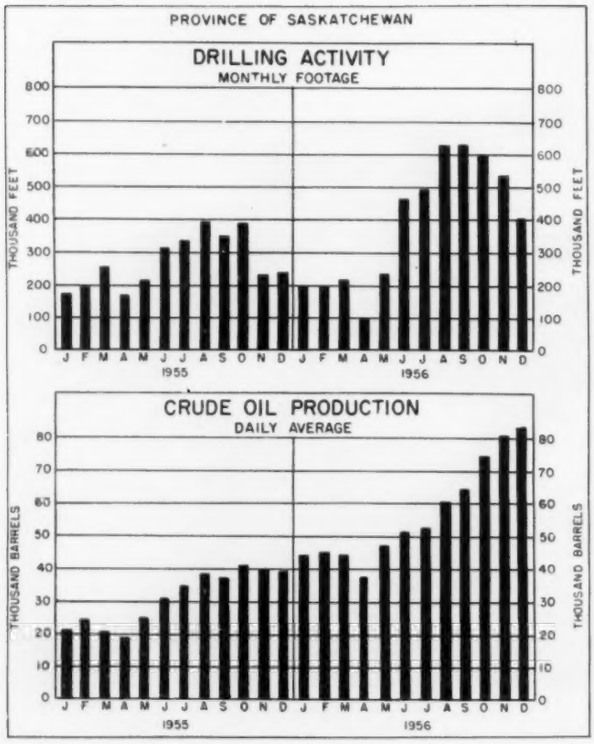

this area. Several of these wells were of considerable significance in that pay-zone sections of close to 100 ft were found. As a result, it now appears that the Weyburn field may well become the largest and most prolific field in the southeastern Saskatchewan area.

The porosity in this reservoir is generally of a fine intergranular-type carbonate, with some vuggy development. The porosity is relatively high, averaging around 17%. In view of the fine nature of this material, the permeabilities are usually low. The field recently has been connected by pipeline facilities. The gravity of the produced crude ranges from 29 to 35 deg API. The sulfur content also varies—being somewhat higher in the lower-gravity crudes. It is understood, however, that all this production is being marketed presently.

The Weyburn field appears to be a large stratigraphic-type trap. Although a number of stepout wells have been drilled in this area, the field has not been fully delineated to date. Reservoir characteristics of the field are complex, in that the majority of the updip wells produce varying amounts of formation water. It is believed that this water production results from lenticular conditions because wells farther downdip produce clean oil. In view of this unique condition, development prior to 1956 was carried out on an evaluation-type basis. However, as a result of finding the highly prolific pay-zone areas, development in this area now is progressing at a rapid rate. It is anticipated that during 1957 a large amount of drilling will be accomplished, and the field more fully delineated. It is of interest to note that, in December 1955, there were 9 wells in the Weyburn field which at that time were only producing around 300 b/d. Production in December 1956 had increased to some 2,900 b/d from a total of 57 wells. In view of the fact that pipeline facilities had not been fully completed at that time, it is anticipated that this production will increase even more rapidly during 1957.

Midale Field: The Midale field, which represents the first major discovery in this area, was effectively placed on production during the latter part of 1956, when pipeline facilities were completed. Production is obtained primarily from the Charles formation in this field. The produced crude has a gravity ranging from 28 to 30 deg API. A high sulfur content, averaging somewhat over 2%, has made the marketing of this crude difficult in the past. With the advent of pipeline facilities, the production now is being marketed more readily. The reservoir development is of a highly erratic nature, and it is difficult to predict conditions from well to well. Nevertheless, drilling has continued at a rapid rate. The number of wells capable of being operated has increased to 181 in December 1956 from 76 in December 1955. Production during December 1956 averaged 8,000 b/d, compared to some 2,300 b/d a year previous.

It is understood that the productive capacity of the wells in this field has not been so high as originally believed; therefore, it is apparent that the reserves may be somewhat lower than those previously anticipated. In a number of the wells, water is produced with the oil, and conditions somewhat similar to those found in the northern part of the Weyburn field are apparent. In general, the reservoir development in this field is poorer than that found in the Weyburn field. It is evident, however, that substantial reserves exist.

It is interesting to note that there have been several discoveries between the Weyburn and Midale areas (see accompanying map). Although it is unlikely that a continuous development exists between the two fields, substantially more production may be obtained. Several wells have been discovered between the Midale and Steelman fields which appear to be of considerable importance, since further production now may be anticipated in that area.

Steelman-Kingsford Field: The Steelman-Kingsford field area extends for some 20 miles from the Kingsford field in the west to the Frobisher field in the east. This field also appears to be the result of a large stratigraphic trap in the Charles formation. The Steelman and East Kingsford areas are apparently one large field. It is believed that the Kingsford and Frobisher fields are essentially extensions to the main reservoir; however, further development will be required to substantiate this belief. The gross pay-zone development in these fields is generally less than that found in the Midale and Weyburn areas. However, the gravity of the crude is higher, and there is a greater amount of gas in solution. As a result, it is believed that the primary recoveries will be relatively higher. In the central portions of the Kingsford area pay-zone thicknesses in the Midale zone have been reported to be in excess of 50 ft. There are also some portions in the central part of the Steelman fields with pay thicknesses of close to 30 ft. Development such as that found in the prolific portion of the Kingsford field would indicate primary reserves in the order of 500,-

SOUTHEASTERN SASKATCHEWAN AREA
DATA ON PRINCIPAL FIELDS
DECEMBER 1956

Field	Weyburn	Midale	Steelman-Kingsford	Alameda-Oxbow	Florence-Carnduff	Alida	Nottingham
Discovery date	Dec/54	May/53	Jan/55	Aug/56	June/56	Nov/54	Feb/55
Principal producing horizon	Charles	Charles	Charles	Charles	Charles	Mission Canyon	Mission Canyon
Average depth (ft)	4,500	4,600	4,700	4,350	4,150	3,650	3,600
Oil gravity (deg API)	28-35	28	33-40	39	39	40	37
Wellhead price of crude ($/bbl)	$1.75	$1.87	$2.45	$2.40	$2.28	$2.61	$2.59
Present spacing (acres)	80	80	80	80	80	80	80
Number of wells as of Dec. 1956	57	181	321	10	47	29	40
Producing rate as of Dec. 1956 (bbl per day)	2,900	8,000	16,400	200	1,800	1,200	3,500

000 bbls for an 80-acre-spacing well. It is believed that the average well reserves in these fields would be in the order of 125,000 bbl per 80-acre location. This field is presently the largest producing area in southeastern Saskatchewan. An extensive amount of drilling has been carried out in this area during the past year. In December of 1955 there were only 61 wells capable of being operated, whereas in December of 1956 there were some 321 wells. An average of somewhat more than 20 wells per month was completed during this period. Production increased to around 16,400 b/d in December 1956 from 2,500 b/d in December 1955.

Some Mission Canyon production has been found in this area, the majority of which is located in the Kingsford sector. Although a sizeable volume of reserves is indicated in this lower zone, the majority of proved reserves is believed to be in the Midale zone of the Charles formation. It is interesting to note that sink holes have been found within the Midale zone producing area which are essentially void of oil production. In those instances where the Midale zone is found at an unusually high elevation, Mission Canyon zone production frequently is found below it.

A strong water drive is evident in the Mission Canyon zone; however, water-breakthrough problems are severe. The Midale zone reservoir appears to be producing primarily from a solution-gas-drive mechanism. Therefore, it is believed that the primary recoveries will be low. As a result, it is possible that pressure maintenance may be considered to effect an increase in the recoveries. It is believed that, if such a scheme were found to be feasible, recoveries may well be doubled in that field. It is, therefore, possible that reserves in the order of 250,000 bbl per 80-acre location might be realized eventually.

Alameda-Oxbow Area: Two signficant discoveries were made in that area between the Florence-Carnduff field and the Frobisher field during 1956. The Alameda field, which appears to be the smaller of the two, is situated close to the Frobisher field. Production is obtained from the Midale zone of the Charles formation. The produced crude is light in gravity, and readily marketable. The reservoir development in this field is more limited than that found in other areas of this trend; however, further stepout drilling may prove up more prolific areas.

The Oxbow field is situated immediately southeast of the Alameda field, and both areas eventually may be found to be one reservoir. Production in this field is also found in the Midale zone of the Charles formation. The reservoir characteristics appear to be somewhat better than those found in the Alameda reservoir. Both the areas in question are relatively recent discoveries, and development to date has been limited. Since the discovery of these fields in the summer of 1956, some 10 wells have been drilled in the Oxbow area and 7 wells in the Alameda area.

Florence-Carnduff Field: The Carnduff field was discovered prior to 1956; however, the significance of this area was not realized until stepout drilling in the Florence area proved the field to be of major importance. The majority of production is obtained from the Midale zone of the Charles formation. The Florence area of the field has been developed rapidly since its discovery. Since June 1956, more than 40 wells have been drilled and completed in the area. Pipeline facilities presently are planned for this area; however, until such a system is in operation, production probably will be somewhat curtailed. The produced crude from the Midale zone has a gravity of approximately 39 deg API. A number of Mission Canyon zone wells also have been completed in this area; however, it is believed that the majority of production will be obtained from the Charles formation. It appears that this field should have an appreciable areal extent. The principal reservoir mechanism in the Midale zone reservoir probably will be a solution gas-drive. In view of the low order of recoveries common to such a reservoir mechanism, pressure maintenance no doubt will be considered. On the basis of primary recoveries, it is believed that an average Midale zone well on 80-acre spacing will have a recoverable reserve of around 80,000 bbl. Pressure maintenance may well double these recoveries.

Alida-Nottingham Area: The Mission Canyon formation is the principal producing horizon in this area. The accumulation of oil in this pool occurs in sharp nosing-type features which are believed to be the result of erosional conditions. Tilted water tables have been noted in most cases. A thick oil-water transitional zone often is found beneath the oil zone. The combination of the sharp nosing features and the unusual water-table conditions have created severe problems in the drilling and completion of the wells. In several cases a gas cap has been found in these reservoirs; however, in all instances a strong water-drive is believed to exist. There is a strong tendency for the water to break through and cause a severe producing problem. In several instances, such as the North Hastings reservoir, recoveries in the order of 5% are indicated. In view of this problem, development and exploration drilling in this area has not been carried out so rapidly as originally had been anticipated.

During 1956, the Southeast Saskatchewan area was explored actively. This program resulted in some 35 Charles and Mission Canyon discoveries. It is believed that many of these discoveries will be indicative of important new fields. In view of the high discovery ratio to date, 1957 also should be a very successful year. Development of the existing fields during 1956 was carried out at a very rapid pace. Although a number of the fields in question appear to be nearing full development, it is believed that during 1957 a large program still will be carried out, particularly in the newer fields. It is, therefore, evident that in 1957 activity will continue at a high level in the province of Saskatchewan. END

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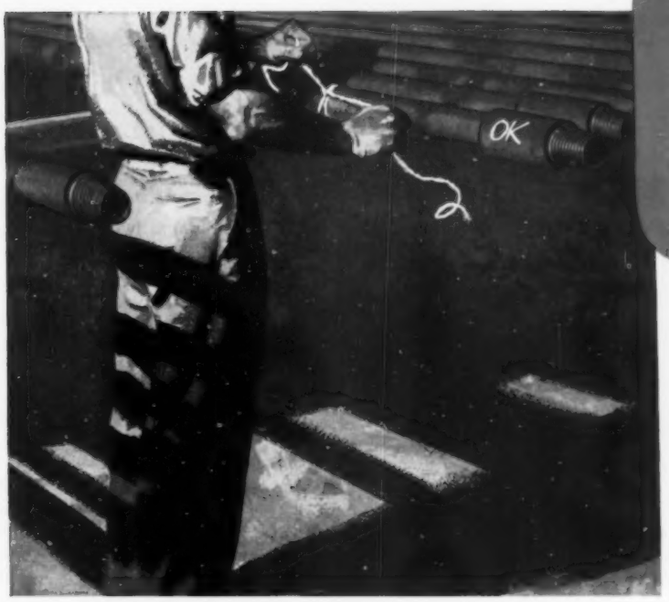

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Eastern Canada

OIL AND GAS PRODUCTION SHARPLY HIGHER

DRILLING activity increased 10% in eastern Canada in 1956 as operators stepped up their exploratory and development work. Output of crude oil rose 14%, to 1,680 b/d, and natural-gas production was up 21%, to 13.3 billion cubic feet.

Renewed interest in the east is indicated by the granting of permits covering 1,423,000 acres in the region. In the Quebec part of the St. Lawrence lowlands alone, 815,000 acres were acquired. Imperial Oil Ltd. has been active in this area with structure drilling and geophysical reconnaissance.

Of the 13 wildcats completed in this area in 1956, one was a gasser and the remainder dry. Oil Selections Ltd. found 1.5 mmcf per day of gas in the Ordovician at 1,235 ft. Stepout wells are being drilled to evaluate the scope of the discovery.

In the Maritimes, permits were granted on 288,000 acres in Nova Scotia. Gravity surveys were conducted on Prince Edward Island. Two slim-hole tests were drilled in the Deer Lake area of Newfoundland. A deep test by New Peninsula Oils in the Gaspe region was abandoned at 8,138 ft. Two development wells in the Stoney Creek field in New Brunswick yielded gas, with an average initial open flow of 500 mcf per day.

As has been the case in past years, most of the 438 wells drilled in eastern Canada were in southwestern Ontario, where oil was found even before the drilling of the Drake well in western Pennsylvania. The St. Lawrence, Gaspe, and Maritimes accounted for 18 wells, and southwestern Ontario for 420 wells.

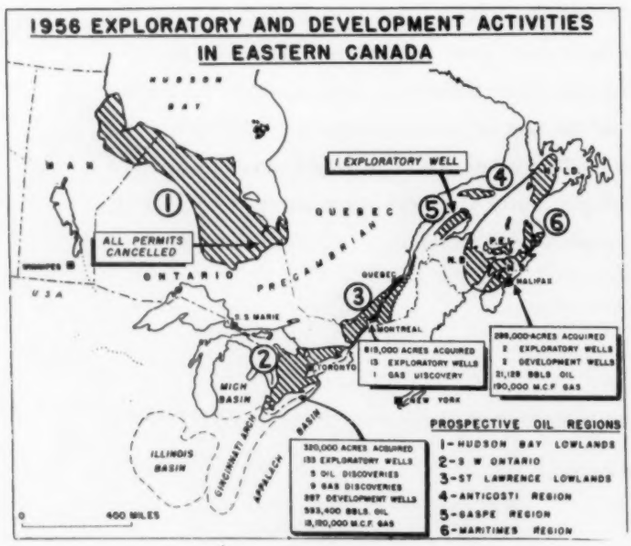
Of the 420 wells drilled in southwestern Ontario, 133 were classed as exploratory and 287 as development. The wildcats had a success ratio of about 10%—with five oil wells, nine gassers, and 119 dry holes. Of the development wells, 69% were successful; 52 gassers, 148 oil wells, and 86 dry. Producers obtained 320,000 additional acres during the year for future exploratory drilling. Much of the development drilling in Ontario was in the Clinton-Medina area in Norfolk County, where 121 gas wells were drilled with an average initial of 60 mcf per day. Greatest concentration of oil-well completions was in the Rodney field area, where new wells come in with an initial of about 19 b/d. Offshore from Kent County and in Lambton County, six oil wells, 25 gas wells, and 15 dry holes were completed.

Details of operations in eastern Canada will be published in the June issue of the *AAPG Journal* in a paper prepared by W. D. Brittain, chief inspector of the Ontario Fuel Board, and J. D. McAlary, geologist for Imperial Oil Ltd. The accompanying map and foregoing data were taken from this paper.

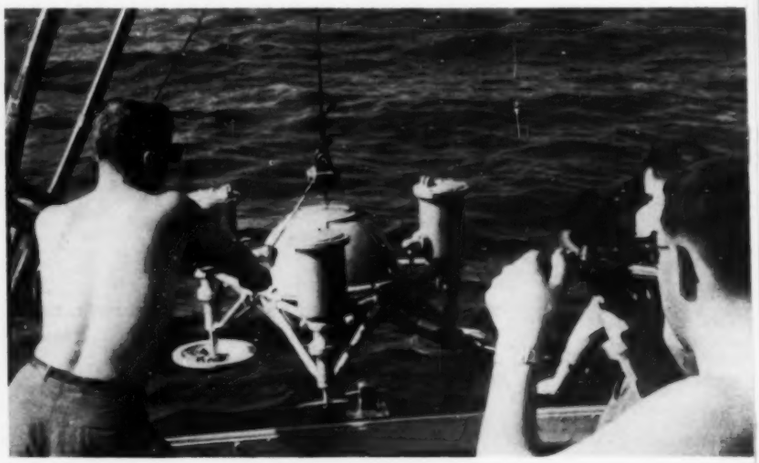
Considerable work is going on offshore, where oil and gas operators are showing increasing interest in drilling for natural gas beneath the bed of Canadian Lake Erie. Consolidated West Petroleum Ltd., of Toronto, has 23 gas wells in the lake in production, and is speeding up its drilling program off Port Alma.

While total production has not been given, the seven wells last year had a combined open-flow potential of 11.5 million cubic feet per day. Of the first four wells brought in this year, three had capacities of 2.3, 1.7, and 1.25 million cubic feet daily.

Cost of a well is estimated at $25,000. Bottom-hole pressure has run about 500 psi. The gas has some sulfur, and must be purified. The gas lies in an extension of the Tilbury field which has been producing gas since 1909. Some 400 wells have been drilled



Lowering delicate under-water gravity meter into the waters of Lake Erie at Leamington, Ont. (Photo courtesy of Imperial Oil Ltd.)



Activity in Eastern Canada increased during 1956, sharp rises in both production and drilling. No oil discoveries resulted from 1956 work, but gas development is strong, particularly in the offshore area of Lake Erie.

Imperial Oil is presently exploring in Lake Erie. Leaning grotesquely with two of its three adjustable legs raised, an under-water gravity meter gets some last-minute adjustments on the dock before being taken out for a day of survey work.

to define this field. A triangular area, the field has an apex onshore some six miles north of Port Alma. The base is nine miles long in the lake. How far the field may extend beneath the lake is yet to be discovered.

West Pete drills in 50 ft to 65 ft of water, and lays its plans for drilling in water as deep as 78 ft. A relatively inexpensive and rapid method was developed.

The first step is to sink four heavy sharp-ended brace pipes in the lake bed at the drilling site. Sections of the drilling platform are towed to position, attached together, and dropped. Three or four sections may be needed, depending upon the depth of the water. Gables from the brace pipes are attached to the platform, and the whole structure is made tight and leveled. Final step is to install a heavy floor, the drilling rig, and a portable bunkhouse and kitchen atop the drilling platform, about 15 ft above the water level.

Cable tools are used as more economical and satisfactory than rotary in the old, hard rock of this section. A large drill bit is used for the first 700 ft, and the hole is lined with 10-in. drill pipe to this depth. A lining of 7-in. drill pipe is inserted, along with a rubber sealer to close the space between outer surface and inner surface at the 700-ft level. A smaller bit is dropped down, and the hole is drilled without lining pipe, as the lower rock is hard and does not cave in.

When the well is completed and producing gas, the pipes are cut off just above the level of the lake bed. A control valve is installed on the 7-in. pipe. If feasible, the well is connected to the company's gathering system. Brace pipes and drilling platforms are then disassembled and floated to the next drilling location. Whenever possible, pipes are filled with air for maximum buoyancy and ease of handling.

Present market price of the gas is about 35 cents per MCF. Union Gas Co. takes West Petroleum's entire output.

Ontario's new regulations cover exploration licensing in Lake Erie, the Detroit River, Lake St. Clair, the St. Clair River, and Lake Huron. They were approved, November 10, 1955, and effective in the spring of 1956. Among the provisions are:

The limit is three drilling areas to a single lessor. A drilling area is up to 24 square miles. A total of $500 for each acre the first year, and $1,000 for each of the next two years, must be spent by the lessor to keep the option; upon the discovery of gas, the lessor pays Ontario 4 cents per MCF.

A drive to change the development expense part is on. Oil and gas operators want the expense to be a minimum for a drilling area, rather than for an acre.

As of September 16, 1956, exploratory licenses had been issued covering most of the northern shore of Lake Erie. In addition, two licenses had been issued which covered the entire Canadian portion of Lake St. Clair and a further license covering an area at the south end of Lake Huron.

Approximately 40 additional applications now are on file for parts of the bed of Lake Erie. Pending contemplated changes in the regulations, they were being held up. Control of actual drilling and exploration comes within the jurisdiction of the Ontario Fuel Board, 4 Richmond Street East, Toronto.

END

Canadian Gas Developments

(*Continued from page 71*)

densed steam. The climate in winter is about as cold as anywhere in Canada, and heating costs are very high. With delivery of gas through Trans Canada, there should be general rejoicing in a supply of a premium fuel at lower cost than at present.

British Columbia: In British Columbia, with population largely concentrated at the coast, the mild winters call for much less house heating than on the prairies; but, even in Vancouver, people want heat when the ground becomes covered with snow. Propane is in use as well as domestic fuel oil, but probably natural gas will be used in preference to other fuels when gas becomes available.

Appliances: With the forthcoming delivery of gas to eastern Canada and to the Pacific Coast, makers of gas-burning appliances should have a field day. It is true that many now heat their homes with oil; but there is a general feeling that, if gas is available, it will be used in preference. As an example, an increase in the price of oil of one cent a gallon is equivalent to six cents per MCF for gas. Ontario recently increased the tax on gasoline by 3 cents, up to 12 cents a gallon, and diesel oil used on the roads to 20 cents per Imperial gallon. While these taxes may not apply to oil for house heating, this is an example of how heating costs from oil can be affected. Oil requires a storage tank; is dirtier to use; and not nearly so handy as gas for cooking, water heating, and similar uses.

Many housewives in Ontario now cook with electricity. Some even in Calgary do so and like it. But we are told that Ontario has now developed most of its economic hydro power, except power to come from the St. Lawrence seaway, and at the present rate of growth of demand even that supply will be absorbed almost as soon as it is developed. Several big thermal stations even now are needed to eke out the hydro supply. The time may not be far ahead when Ontario Hydro will have to limit heating and cooking loads, and people now cooking with electricity may be forced to use gas even if they do not do so voluntarily.

Hence, when Trans Canada gas reaches eastern Canada, gas furnaces, gas cook stoves, and water heaters will be in big demand—and the money to buy them is likely to run into figures like $500 million over the period of changeover.

Right here, we would put in a plug for the laboratory which has been maintained in Calgary over a long period of years which tests appliances and issues its approval certificate if found satisfactory. Calgary was one of the very early cities to use natural gas, and the supply dates back to 1912. Realizing the need of eliminating appliances which were dangerous, the Canadian Western Natural Gas Co. established the laboratory, and later Northwestern Utilities came in; so the work has actually been supported by the two big Alberta distributors. Reports go to the Calgary Gas Approval Board, which actually issues the certificates.

In the electrical industry, the Canadian Standards Assn. acts as approval authority, and it looks now as if a central authority would be in order. If Ontario, Quebec, Manitoba, Saskatchewan, and British Columbia were each to do analogous work, we can see much duplication of effort and lack of standardization. The Calgary laboratory has done most valuable work in the past, and has already approved many appliances. Those in charge of the laboratory claim that tests at the high altitude of Calgary—around 3,500 ft—are likely to find faults which would not be noticed if testing were done closer to sea level. They claim that, if appliances pass at Calgary altitude, they will pass at lower altitudes; but the reverse is not necessarily true. END

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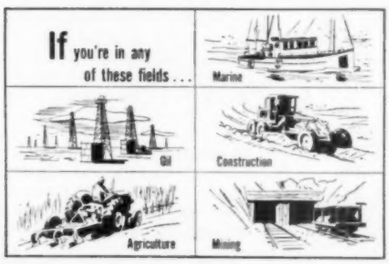

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Oil Company Staff Changes

O. N. MILLER has been appointed vice president of Standard Oil Co. of California. Miller has been a vice president of Standard's Western Operations Inc., the company's operating subsidiary in the seven western states, Alaska, and Hawaii. He joined California Standard in 1934, and served as general manager of Standard's manufacturing department for eight years, from 1946 to 1954. His experience covers both the research and refining fields, including planning and design of the Ras Tanura refinery in Saudi Arabia. He is a graduate of the University of Michigan.

THOMAS L. APJOHN has been appointed manager of the newly created petroleum chemicals department of Mobil Overseas Oil Co. In addition to acting as a clearing house for activities in the petroleum chemical field, the new department will initiate market research studies, recommend laboratory research programs, and evaluate overseas opportunities in manufacturing and marketing related to petroleum chemicals. Mobil Overseas is an affiliate of Sonocy Mobil Oil Co. Inc. Prior to his new assignment, Mr. Apjohn was manager of Mobil Overseas' lubricating department.

Elmer D. Erney

ELMER D. ERNEY has been appointed manager of the purchasing department in the headquarters office of Cities Service. He succeeds John J. Dorr, who has been appointed manager of trade relations. Mr. Erney formerly was purchasing agent for one of the principal Cities Service subsidiaries, Cities Service Oil Co. (Pa.). He is succeeded in that position by Frank T. Whitty, former assistant purchasing agent.

ARTHUR A. (DUKE) CURTICE has been named president and general manager of Signal Exploration Co., foreign subsidiary of Signal Oil and Gas So. Signal Exploration is the operator in Venezuela in a joint venture with subsidiaries of The Standard Oil Co. (Ohio), Hancock Oil Co., and The Pure Oil Co. Mr. Curtice's headquarters will be in Caracas. An internationally eminent geologist and petroleum engineer, he was associated with Herbert Hoover, Jr. and Glen Ruby from 1942 until 1952, heading the firm of Hoover, Curtice and Ruby, SA. This firm carried on work for the Corporacion de Fomento de la Produccion of Chile which resulted in the discovery of the first oil field in Chile. In 1944 they acted as technical advisors to the Prime Minister of Iran and similarly aided President Dutra of Brazil in 1947. The firm also managed the campaign of petroleum exploration and drilling in Naval Reserve No. 4 on the arctic coast of Alaska for the US Navy. Mr. Curtice played a major role in shaping the present Venezuelan oil law, which has been so successful.

During 1945 and 1946, Mr. Curtice was petroleum consultant to the government of Peru, and wrote the preliminary draft of a petroleum law and regulations of Peru. From 1949 to 1954, he was president of Conorada Petroleum Corp., and from 1954 to 1956, he has been a consultant on Venezuelan oil problems.

FRED J. MYERS has been appointed general manager of the Western Division of Hammond Iron Works, with headquarters at the Provo, Utah, offices. Mr. Myers has spent the last few years as Warren, Pa., district sales manager.

Fred J. Myers

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K. C. Thompson

K. C. THOMPSON has been named geophysical supervisor for foreign operations of Pan American Petroleum Corp. He will be responsible for overall coordination of the geophysical programs of Pan American subsidiaries operating in the area.

K. W. KENDRICK has been elected regional vice president of Standard Oil Co. of California, Western Operations Inc., for southern California.

R. N. HARDING has been appointed managing director of Caltex Pacific Oil Co., in Indonesia. Former managing Director A. B. Brown is returning to service with Standard Oil Co. of California after two years with Caltex Pacific. Mr. Harding previously was deputy managing director of Caltex Pacific. He is a 1936 graduate of Texas Technological College, joined The Texas Co. the following year, and engaged in exploration work with that organization for 18 years in the USA and Canada as a computer, surveyor, field operations executive and, finally, as superintendent of the Northern Foothills Project in Calgary, Alberta.

GRAHAM F. TOWERS has become chairman of BP (Canada) Ltd., the Canadian member of the International BP group which is entering the petroleum-products market in eastern Canada and is planning the construction of a refinery in the Montreal area. Mr. Towers, who until 1954 was governor of the Bank of Canada, is a member of the Canadian Committee of the Hudson's Bay Co., and includes in his directorships the Canada Life Assurance Co., Canadian Investment Fund Ltd., and Bell Telephone Co. Ltd.

C. A. WILLNER has been named division geophysical supervisor of Pan American Petroleum Corp., and M. R. Hewitt has been appointed district geophysicist at Pan American's North Canadian district. Mr. Hewitt was formerly staff geophysicist at the same office. The North Canadian district office is in Calgary, Alberta.

GEORGE F. GETTY II, director and vice president of Tidewater Oil Co. and general manager of its eastern division, has been elected a director of Mission Development Co. Prior to joining Tidewater last year, Mr. Getty served as executive vice president and director of Pacific Western Oil Corp., now the Getty Oil Co., and as vice president and director of Spartan Aircraft Co., Tulsa. He was also president of Minnehoma Financial Co. and Minnehoma Insurance Co., subsidiaries of Spartan Aircraft.

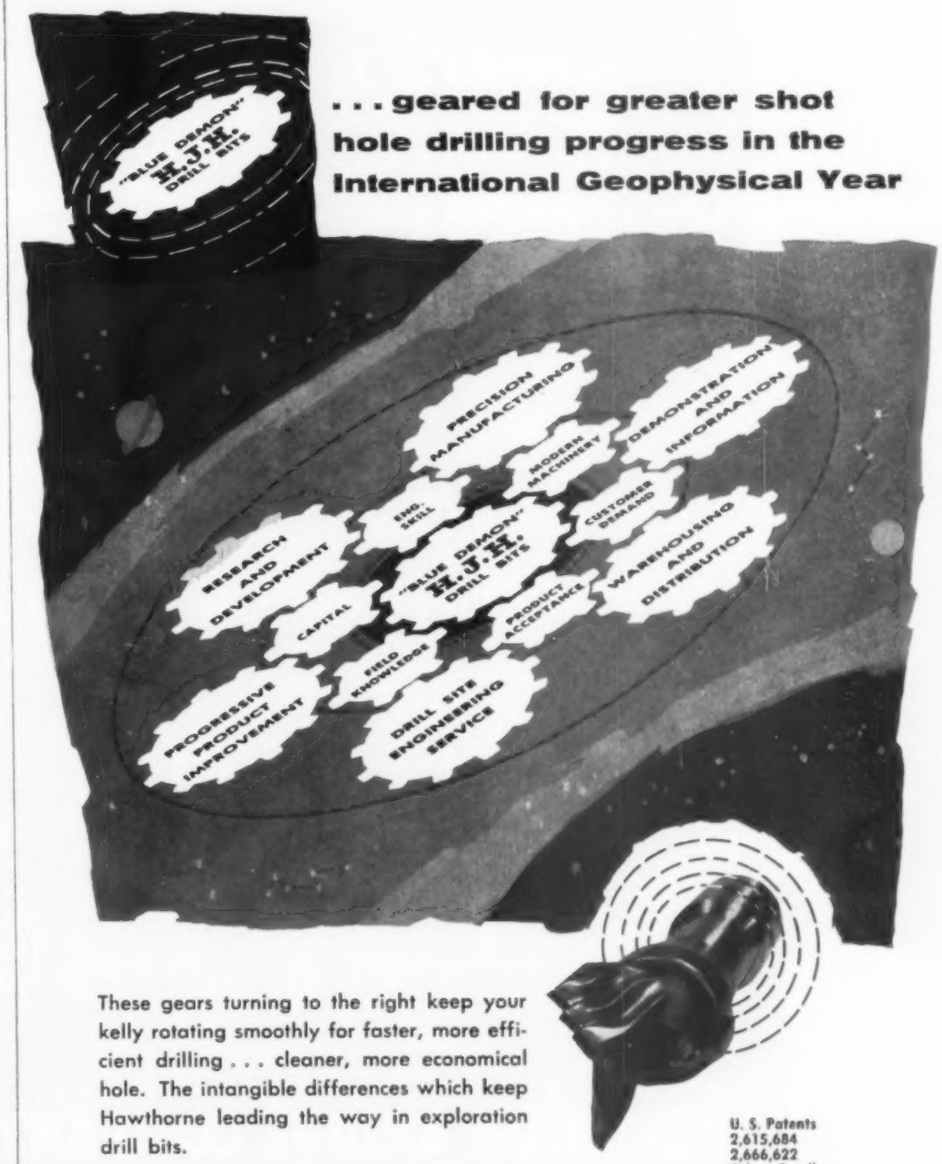
PAUL M. YOUNGMEWER, assistant manager of the Rexaco Exploration Co. at Calgary, has been transferred to Venezuela to become assistant manager, exploration, for Texas Petroleum Co. His headquarters are to be in Caracas. At Calgary he has been succeeded by Raymond D. Holland, formerly geological supervisor at that office.

FRED POWELL has been appointed vice president and director of Standard Oil Co. of California Western Operations Inc. Powell, heretofore manager of the Western Operations Inc., manufacturing department, joined Standard in 1925, and previously served as manager of the company's El Segundo refinery and as assistant manager of manufacturing. He was also formerly president of California Research and Development Corp., a now-dissolved Standard subsidiary. A native of Portland, Powell is a graduate of the University of Washington.

HINES H. BAKER has retired as director and president of Humble Oil & Refining Co. He will be proposed to the stockholders for election to the Jersey board of directors at the annual meeting to be held on May 22, 1957. If and when elected, he will succeed J. E. Crane, who is not a candidate for re-election, to the Jersey board. Mr. Crane is a member of the executive committee, and until recently was also a vice president. Mr. Baker has been president and chief executive officer of Humble since May 1948. He is a graduate of the University of Texas, with bachelor-of-arts and law degrees.

D. J. MORGAN and W. R. Young have been appointed district managers for British Columbia and Saskatchewan, respectively, by Royalite Oil Co. Ltd., Calgary—along with other changes in the company's marketing and manufacturing divisions. The company said its new marketing appointments had been made "to correlate more closely to our expanding operations."

Hines H. Baker



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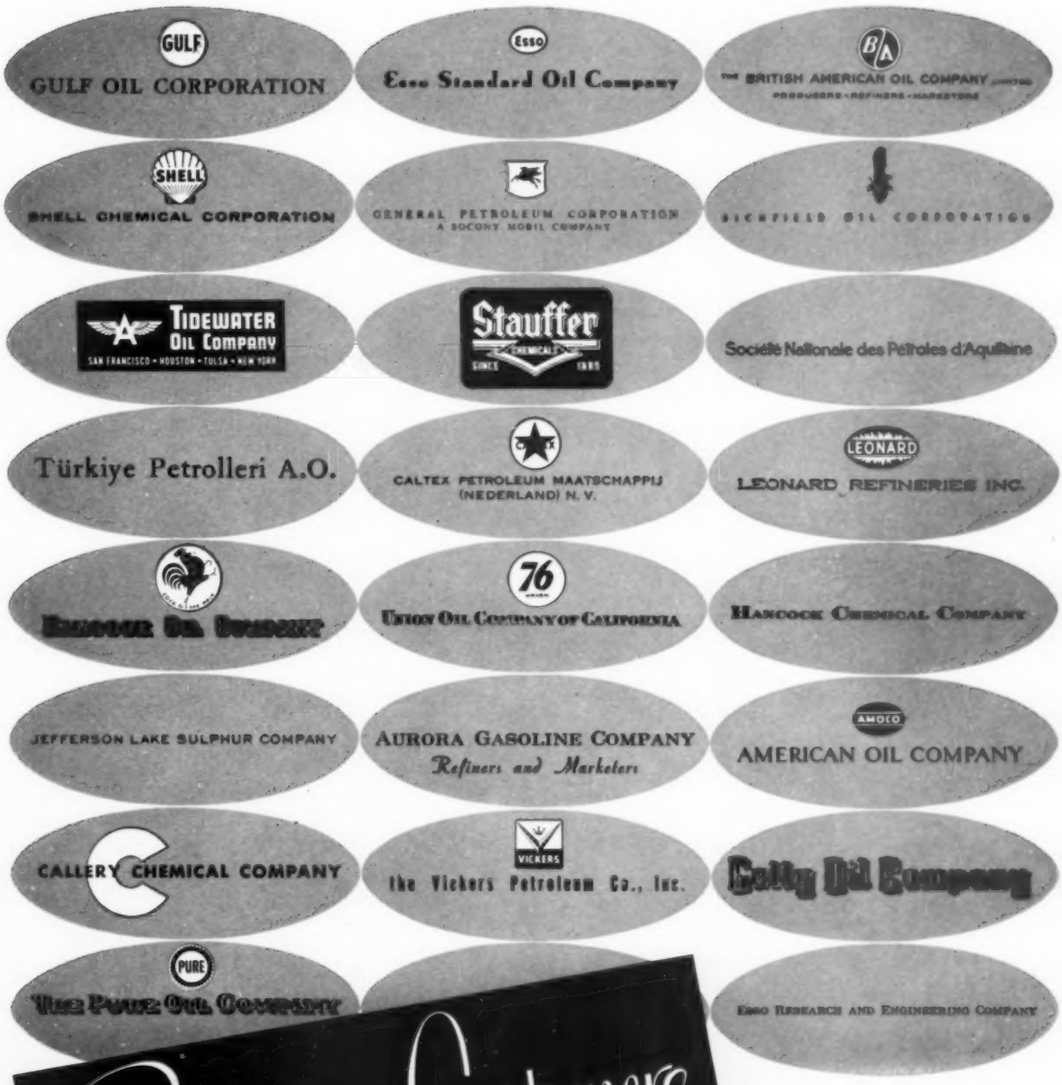
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NEW "SELF-SEALING" RING GASKET

Cameron has developed a new gasket for standard API flanges.

Internal pressure is used to assist in effecting a safe, sure seal with only a fraction of the bolt tightness needed by conventional API gaskets. This reduces nipple up time to a minimum and gives greatly increased protection against leakage resulting from drilling vibration, rough handling or test pressure loads. You can forget about frequent, time-consuming bolt retightening.

AN OPEN LETTER TO THE OIL TOOL INDUSTRY

Cameron is making the "Self-Sealing" Ring Gasket available to the industry.

Along with every other member of the industry, Cameron has been constantly concerned with the problem of maintaining tight API flange connections.

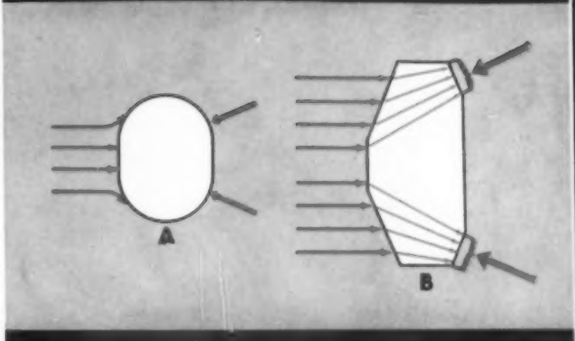
Difficulties and expense have long been experienced because stud bolts had to perform the double duty of holding pressure while keeping the gasket compressed.

The obvious answer to this problem is to use internal pressures rather than bolt loading to effect a seal.

Cameron, through extensive research and development, has produced the "Self-Sealing" Ring Gasket design. Increasing ring height and proportionately increasing loading by pressure on the outer face of the ring has created a self-sealing condition.

To the advantage of all concerned, Cameron is releasing this design to the industry without requiring license fees or manufacturers' royalties.

New "Self-Sealing" Ring first makes contact on this outer surface creating an initial seal. Even with wear on both ring and flange, low torque will effect a perfect seal. Increased pressure increases tightness of seal.



A. The small curved contact areas of the old style ring gasket effect a seal only with high bolt loading. Because they yield under load, continuous retightening is necessary. Internal pressure does not aid in maintaining a seal.

B. The "Self-Sealing" Ring Gasket utilizes the force of internal pressures to increase sealing effect over the two broad surfaces on its outside diameter. Contact areas with the flange groove are increased tremendously. The result is better sealing effect and much greater load carrying ability.

This view shows increased height of the new "Self-Sealing" Ring. Larger contact areas increase mechanical stability with low bolt loading.

"Self-Sealing" Ring Gaskets are manufactured in sizes to replace old style API rings from 6" 3,000 lb. through 14" 5,000 lb. All other standard sizes available on special order. These gaskets use standard stud bolts and nuts. "Self-Sealing" Ring Gaskets may be purchased directly from Cameron or from your regular source. In the event your source cannot make delivery on this new type "Self-Sealing" Gasket, please advise that complete specifications including all engineering data for their royalty-free manufacture may be obtained from Cameron at no cost whatsoever.

This self-sealing principle is also used in a tentative design for 15,000 lb. working pressure flanges.

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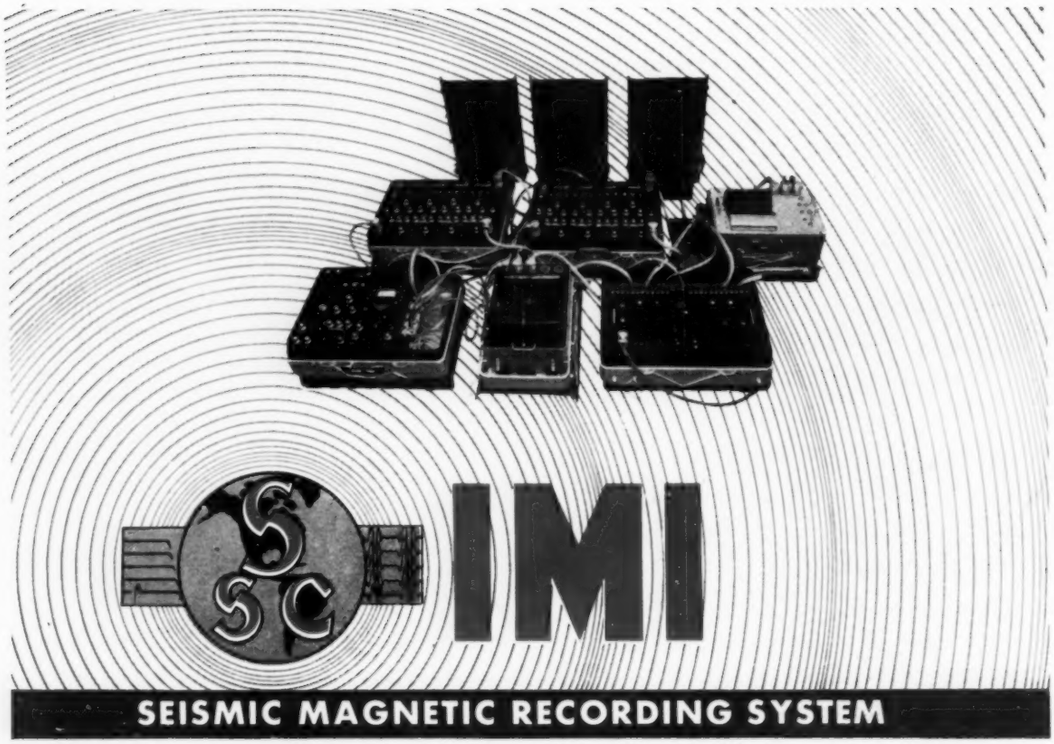

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The amplifiers in the IMI system are precision-built, high-gain, simple to operate, service and test. The assembly uses standard components and ganged controls and is packaged in a small unit space. These features are made possible by the unique assembly of three amplifiers in a single chassis.

The complete IMI system consists of two amplifier cases, two power sources, one magnetic recorder and one recording camera, all in sturdy, light-weight aluminum cases suitable for pack or truck mounting.

IMI is the ultimate in versatility! It may be used as a conventional or high-frequency reflection seismograph or as a refraction seismograph. A 50-trace camera permits recording from the same shot a 24-trace mixed and a 24-trace unmixed seismogram, either with or without magnetic recording. With magnetic recording the photographic monitor record may be used for computation.

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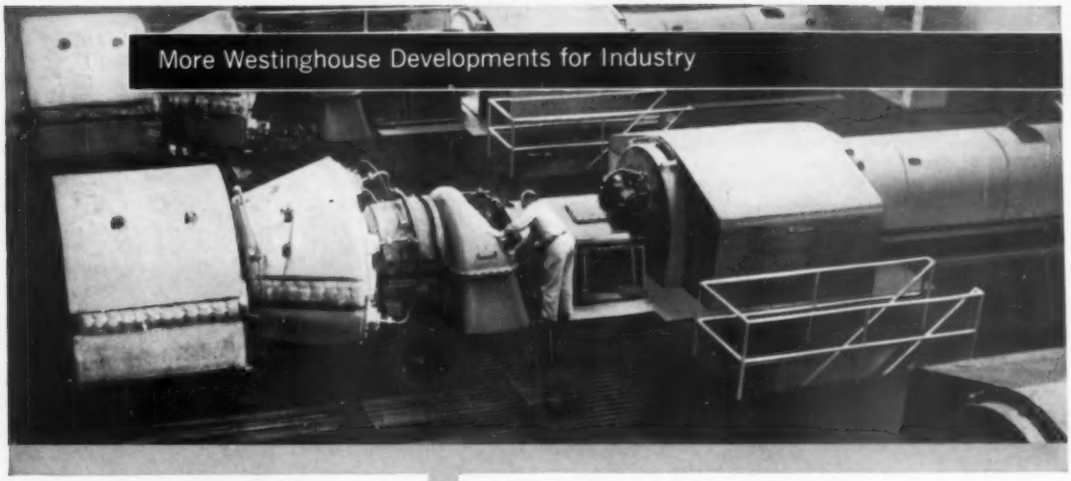
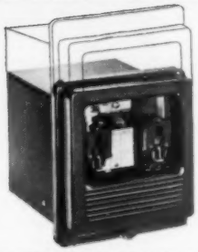
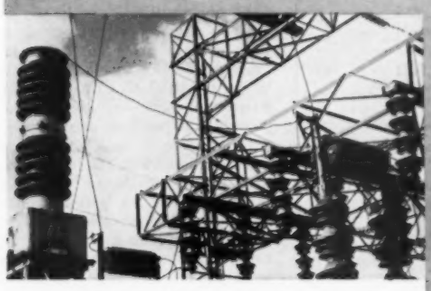
More Westinghouse Developments for Industry





NEW RELAYS SAVE PANEL SPACE

New from Westinghouse—a completely redesigned line of protective relays that require less panel mounting space, yet provide more efficient and dependable operation. Housed in cases one-third smaller than previous designs, they also provide easier accessibility for settings and adjustments. Request "Book J."



POWER-LINE CARRIER "TRANSISTORIZED"

The first completely transistorized power-line carrier assembly was installed recently by Westinghouse for protective relaying. Promising many important advantages, transistorized equipment is smaller, easier to handle (cases of less than ½ cubic foot replace cabinets of more than 17 cubic feet). It effects large savings in station battery power, while long-lasting transistors eliminate most maintenance costs.

This gas turbine runs without a drop of water

Advanced design Westinghouse gas turbines offer you the most practical lightweight, quick-starting prime mover available—*one that can be run without a drop of water.* A special radiator makes the ordinarily required cooling water supply unnecessary. Available in capacities from 3250 hp (2250 kw) to 22,000 hp (16,500 kw), vibration-free Westinghouse gas turbines require only light foundations and absolutely no base plate. This saving on installation in the cost of labor, materials and time, is one more reason for specifying Westinghouse gas turbines. Request "Booklet H" for complete details.

For more information on any of the developments shown here, or for help on your specific engineering problems, write to Westinghouse, Box 345, Wall Street Station, New York 5, U. S. A.

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International News and Notes

New Discovery In Saudi Arabia

The discovery of oil in an exploratory well, drilled 12 miles northwest of the northernmost well in the 140-mile-long Ghawar Field in Saudi Arabia, has been announced by Arabian American Oil Co. The well was drilled to a total depth of 7,325 ft, and completed at 7,120 ft for potential production from the "D" member of the Arab zone. The new well, known as 'Ain Dar well No. 56, is located approximately 55 miles southwest of Dhahran, Aramco's headquarters. Further geophysical work is under way, and additional drilling is planned to assist in evaluating the area.

Austrian Gas Interests Join

By fusion of two rival groups, the "Studiengesellschaft fuer Erdgasversorgung GmbH" (Study Socy. for Natural-Gas Supply Corp.), formed by nationalized enterprises, and the "Fernags GmH" (Long-Distance Gas Corp.), formed by private enterprise, the "Steirische Ferngas GmbH" (Styrian Long-Distance Gas Corp.) was founded recently, whose members are now the province of Styria, the town of Graz, and 20 nationalized and private enterprises. Purpose of the corporation is the laying of gas pipelines from the gas fields in the province of Lower Austria to the industrial centers of Styria.

Cardinal Elia dalla Costa, Archbishop of Florence, intones a benediction, for the first deep drilling rig to be manufactured in Italy. The huge rig, an Ideco-Pignone Super 7-11, was built in Florence by Nuovo-Pignone under a license agreement with Ideco, one of the Dresser Industries. Italian industrialists and statesmen were present at the dedication, as well as G. W. (Jack) Walton, Ideco executive vice president, Dallas. This is the first of a series of 24 units to be delivered to AGIP, the Italian government's company. Nuovo-Pignone's volume is now up to about $15 yearly, and the plant is being modernized.

Plan Panama Test On Cataract Acreage

Time Petroleum Co. of Wichita, Kansas, plans to drill an exploratory test beginning in August on its farmout from Cataract Mining Corp. of New York, in Panama. The farmout covers a concession of more than one million acres in the province of Chiriqui.

Geophysical and geological reconnaissance work has been in progress for some time. First report from R. J. Schreiner, Time's consulting geologist, was submitted to Cataract last December. Reconnaissance work included aerial photogeologic exploration as well as seismic studies.

In addition to its Chiriqui property Cataract has a concession covering in excess of 850,000 acres in the Province of Darien. A geological survey on this tract has been made for Cataract by Dr. Stanislas Kriz. Cost of exploratory work to date on both concessions has been in excess of $250,000 according to Cataract. It was erroneously reported in the March issue of *World Petroleum* that the Cataract concessions had not been ratified.

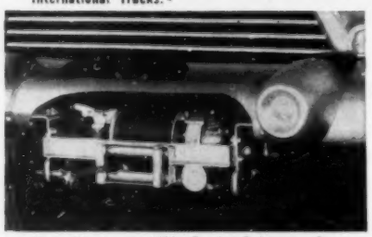
On April 2 Herbert J. Steel, executive vice president of Cataract, was received by President Ernesto de la Guardia, Jr., of Panama. Mr. Steel told the head of the Panamanian government that reconnaissance thus far has indicated the presence of 14 structures which warrant testing.

New Philippine Test

Faire No. 1, in northeastern Luzon, was spudded in, March 23, as the first deep test to be drilled in the Philippines by Standard-Vacuum Oil Co. Located near the village of Faire, 225 air-miles northeast of Manila, the well site is situated on one of eight Stanvac concessions in the Cagayan valley which have an aggregate area of 1,500 square miles. It is sited about 40 miles north of Tumauini No. 1, the Philippine Oil Development Co.'s first deep test which was abandoned last year at 10,414 ft.

Santa Fe Overseas Drilling Co. Inc., a subsidiary of Santa Fe Drilling Co., of Whittier, Calif., is drilling Faire No. 1, under contract, with a "National 55" rig. The Stanvac Cagayan valley venture is headquartered at Tuguegarao, 25 air-miles southeast of Faire. N.B. Sauve is directing Stanvac's exploration in the Philippines.

King Winch for S-120 and A-120 All-Wheel-Drive International Trucks.*



King Winch on GMC Truck. Cut-away shows underslung mounting, featuring new hi-tensile strength design.

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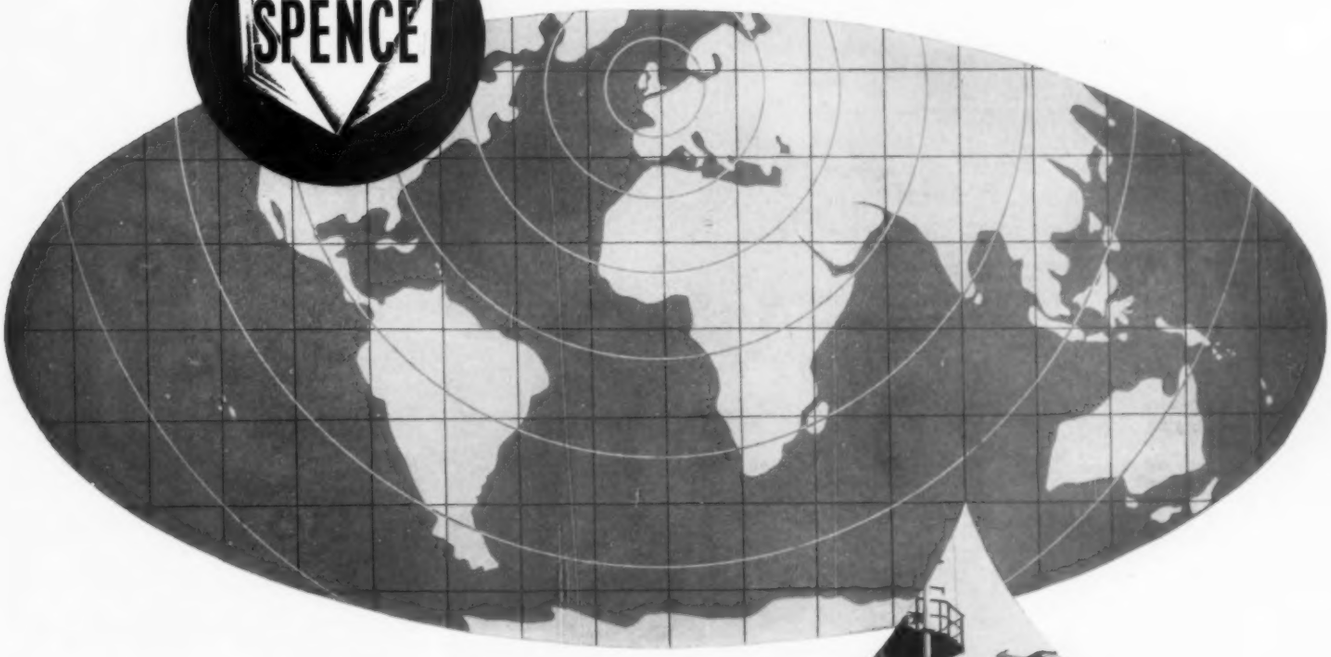

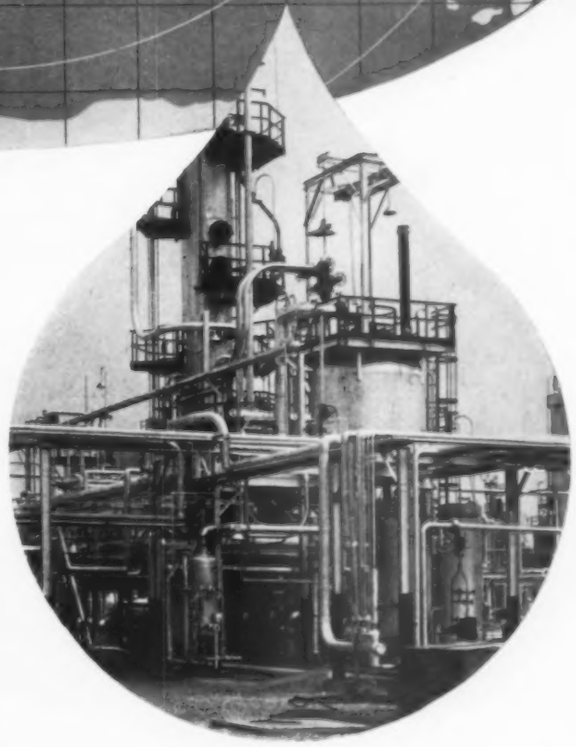

Spence cobalt and molybdenum oxides on alumina catalyst is a sulphur resistant hydrogenation catalyst which is being used in increasing quantities at refineries throughout the world. It is a robust catalyst of high activity, proven by years of service on a commercial scale

Hydrofining unit, Esso refinery, Fawley. This is one of the many plants using Spence catalyst. Photo by courtesy of Esso Petroleum Company.

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Iran To Produce 230 Million Barrels In 1957

Production of oil in Iran during 1957 is estimated at 36,800,000 cubic meters (231,492,000 bbl), compared with 31,094,800 cubic meters (195,606,292 bbl) during 1956. The estimate comes from US officials in Iran, after a check with oil companies and Iranian officials.

The net receipts to the government of Iran from the oil consortium during 1957 then would come to $418,000,000, compared with $138,580,671 during 1956.

During 1955, production was 19,015,000 and payments $84,599,240; during 1954, 1,740,000 and $5,900,086.

Here are figures in more detail on crude-oil production in Iran:

	Iran Production (cubic meters)	*Net Receipts from Oil Consortium*
1955	19,015,000	$ 84,599,240
1956	31,094,800	138,580,671
1957 Est.	36,800,000	148,000,000

New Oil Terminal For South Africa

An oil terminal is to start going up at Mossel Bay on the west coast of the Union of South Africa. The work will take a year.

Qatar Offshore Drilling To Continue

Shell Petroleum Co. has announced that the recent wrecking of its $2.5 million mobile drilling platform in a storm in December will not put a stop to its under-water exploration for oil in the Qatar area of the Persian Gulf. Another drilling platform is to be acquired. A new one would cost over $2.8 million, and would take 2 years to build and get it on the site for drilling; so the company is trying to hire a replacement. The first two wells were disappointing, and were abandoned at 6,700 ft and 12,000 ft, respectively. The next well will be located in the northern half of the concession area, in 80 ft of water. It will be 35 miles from land and 65 miles north-northeast of Doha.

New Concession in Dutch New Guinea

Dutch New Guinea (Surinam) has signed an oil exploration and exploration agreement with Colmar Surinaame Olie Maatschappij NV, an USA oil company owned by Marts Oil Co., Bartlesville, Okla.

The agreement gives a concession for 40 years, under which 12.5% royalty goes to the government. Maximum tax, on top of the royalty, is 50% for income over Sf. 10,000,000 (one Sf. equals 54 cents USA).

US officials say the company is ready to spend Sf. two to three million, although the officials express some doubt whether this actually will be spent.

A test well is to be started in September in the Nickerie area.

The agreement comes after nine months of talks, handled for the company by Edward J. Hanlan, of Orlando, Fla., and Dr. Chin Ten Fung, Surinam politicial, businessman, and dentist. In the past, efforts to find commercial reserves of oil came to little. In 1940, Netherlands Guiana Petroleum Co. (Standard Oil) drilled a test well 4,800 ft in the northwest coastal region, but abandoned it. In 1955, Heap Oil Co. tried for exploration rights, but there was no agreement on the tax bite.

Oil Find In France

The Societe Nationale des Petroles d'Aquitaine, in which The British Petroleum Co. Ltd. has an interest through its French associated company, Societe Francaise des Petroles BP, has announced the discovery of oil at the second well drilled at Clermont, Landes, halfway between Puyoo and Dax. On test, the well produced about 300 gal of oil in just over one hour (about 170 b/d).

SNPA plans to drill further test wells in the area. The discovery is significant in that an entirely new producing formation has been found.

Japanese Heavy-Oil Import Increases

A big increase in heavy-oil imports is expected during the 1957-58 Japanese fiscal year, according to officials of the Economic Planning Board. Coal output of 52 million tons programmed for the 12-month period starting April 1 is not enough to meet the large increase in domestic demand for industrial fuels. Home consumption of heavy oil for fiscal 1957-58 will reach 7.6 million kiloliters (about 47.8 million barrels) as against 6,630,000 kiloliters for fiscal 1956-57. Japan will have to import about 6.5 million tons of coal in the forthcoming period as compared with 3.9 million tons planned for the 1956-57 period.

To Import 10 Million Barrels of Crude

Japanese government authorities will import 9,850,000 bbl of crude oil shortly, at an estimated value of $18.9 million. Of the total emergency import, some 8,340,000 bbl, worth $16 million, will be for general distribution; 1,260,000 bbl ($2.4 million) for the electric-power industry; and 250,000 bbl ($484,000) for the gas industry.

Esso To Have Norwegian Refinery

The Norwegian government has finally agreed to the building of a refinery by Standard Oil Co. (N.J.) near Sarpsborg on the east bank of Oslo Fjord. With a capacity of 40,000 b/d, it will employ 300 Norwegian workmen.

New Egyptian Company

A new company, called Eastern Petroleum Co. of Egypt, has been formed to operate the Egyptian government's oil refinery at Suez. This refinery was originally erected to refine the government's royalty oil from the Gemsah and Hurgada fields, the refined products being used by government departments. Recently the capacity was raised to 1.5 million tons per year (30,000 b/d), and products were distributed commercially.

The initial capital of the new company is £100,000, 29% subscribed by the Government Petroleum Authority, 20% by the Egyptian Societe Cooperative des Petroles, and 51% by the Egyptian Petroleum Co., representing Belgian Petrofina and Italian State AGIP.

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From the first SIE seismic instruments, the GA-7 through the GA-7H . . . to the first concepts in truly portable instrumentation which culminated in the P-11 Series . . . on to the G Series systems for magnetic and photographic recording . . . then the DRF Flow Control Systems and the MR group of field and portable magnetic recorders . . . continuous research and improvement have added new stars to the SIE firmament.
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Bids Open For 4½ Million Barrels of Iraq Crude

Iraq has 4.5 million barrels of crude oil of 1958 for sale to the highest bidder, according to the Ministry of Economics at Bagdad. Bids may be offered before May 31, 1957—deadline to the ministry, or embassies, legations and consulates. Answers will come by June 15, 1957. For sale is expected to be 1,237,500 bbl from Iraq Petroleum Co. and 150,000 bbl from Mosul Petroleum Co., at Tripoli; and 2,175,000 from IPC and 1,000,000 from Basra Petroleum Co., at Banias.

New Iran Pipeline

Societe Entrepose, a French firm, is to start construction soon of a 6-in. oil pipeline in Iran. The line is to run 146 miles from Azna to Isfahan, have a capacity of 6,000 b/d, and cost $5 million. Completion is expected early next year.

Neutral Zone Expansion

American Independent Oil Co. plans expansion of field gathering and marine loading facilities for completion late this year in the Kuwait-Saudi Arabian Neutral Zone. The expansion is to take care of expected production increases.

Pre-Suez, in July, the company had production as high as 44,000 b/d, but the Suez shutdown slowed tanker deliveries. By mid-February 1957, gross production had climbed to exceed 40,000 b/d. For 1956, gross crude production of the company averaged 32,000 b/d, up 32% from the year before.

AIOC has a one-half interest in 2,600-square-mile concession in the Neutral Zone.

Four drilling rigs were active at the start of the year. Some 26 wells were completed in the sands of the Wafra field, just twice the total of 1955. At the start of this year, the field had 56 producing wells.

One of the new wells found the Burgan sand, 1¼ miles east of previously known production. More than 300 ft of productive section has been found in the deeper Ratawi pay.

Canada's Untapped Oil Land holds the Key to a

GOLDEN FUTURE

Today, Western Canada's explored oil lands have brought forth an oil reserve of over three billion barrels. But in years to come, this reserve may be dwarfed into insignificance by the yield of our now-unexplored oil lands.

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As underwriters of Canadian oil securities, one of the objectives of Burns Bros. & Denton is to provide its facilities to both of these groups, to help unlock the oil reserves of the future.

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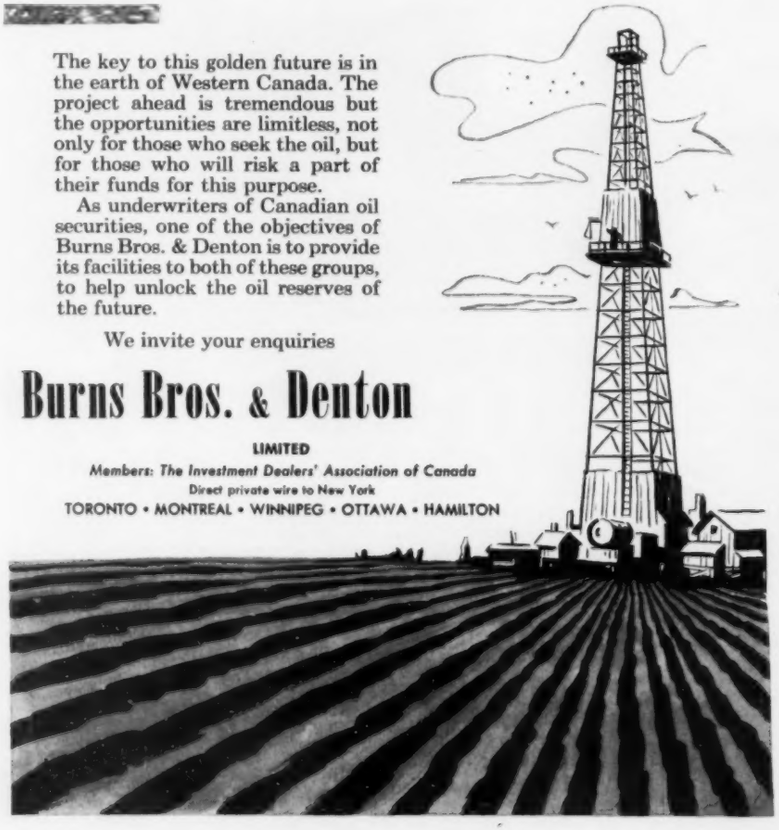

New "Finding" Method For Italy

A joint Italian-American company for oil exploration is to be formed, according to Martin Lerman, an American from St. Louis and president of the American-Greek Oil Co. A "new" exploration method will be used, according to Mr. Lerman.

Hungarian Escapee Heads Geophysical Research

An intensification of geophysical exploration is expected in Austria as a result of the recently founded "Oesterreichische Gesellschaft fuer geophysikalische Forschung mbH" (Austrian Socy. for Geophysical Research Corp.). Scientific director is K. Kantas, a former professor of geophysics at the Technical University of Sopron, Hungary, who fled to Austria a few months ago. Mr. Kantas has also been employed by the Austrian Mineral Oil Administration as scientific advisor in geophysics.

According to *Erdoeldienst*, Vienna, the Austrian Mineral Oil Administration intends to participate in the new corporation.

Assam Drills Near Moran

Assam Oil Co., drilling in India, plans a third well —after a second, near Moran, was successful at 11,300 ft. In Nahorkatiya area, well No. 23 found oil, and drilling is on at No. 24.

Activity Centers Around Ragusa, Sicily

After the disappointing development of the production tests and of further drilling in central Italy, and after tests and of further drilling in central Italy, and after the approval by the parliament and successive promulgation of the new petroleum law—considered discouraging for the foreign companies—Sicily (where a separate law, issued by the local authorities, operates) is at present the part of Italy where exploration and drilling activity are more intense. At February 1957, areas covering more than 3.3 million acres had been granted to Italian and foreign private companies, and to the ENI subsidiaries, by the region's authorities. Many applications are still pending.

The activity of greatest interest is centered in the southeast part of the island, where oil was found in commercial quantity by the Gulf-Italia in 1953 in the immediate vicinity of Ragusa. Ragusa field produced, in 1956, 3.4 million barrels of 19 API crude, about 81% of the whole Italian production, from 18 wells. Production rate at Ragusa is presently close to 18,000 b/d; proved reserves are 140 million barrels.

Gulf-Italia has recently drilled five exploration wells elsewhere in southeast Sicily: at Giarratana, Chiaromonte, Licodia, Buccheri, and Comiso—all unsuccessful. A joint Gulf-Montecatini enterprise has carried on geologic and geophysic prospecting on the area between Petralia and Castellana, in northeast Sicily, where drilling is presently under way—no definite result being known.

In the plain south of Catania, an ENI subsidiary has drilled several wells. Gas has been found and is presently produced in limited amounts (54,000 cubic meters per day) and used in a nearby thermoelectric power station. In the same area gas has been found by ARPE (Esso-RASIOM) in a quantity not yet evaluated.

Near Vittoria, the British Petroleum Co. subsidiary CISDA has found extremely viscous, uncommercial crude at about 9,000 ft. No exploitation is possible owing to the quality of the crude found.

The most interesting result of 1956 exploration activity in Sicily is probably the discovery near Gela by AGIP-Mineraria (ENI group) of 10 API crude at 9,100 ft. The first well flowed about 120 b/d; three more wells are being drilled; and pumping will be applied in order to increase production to at least 300 b/d to 400 b/d. The same company is also at work at Modica, southeast of Ragusa, on an area previously abandoned by Gulf-Italia, and at Rosolini (Siracusa) where turbodrilling is being tested. Turbodrill used is manufactured by the French company Neyrpic. A joint enterprise of AGIP-Mineraria and Snia Viscosa recently found "wet" natural gas in commercial amount at Enna, and near Trapani in western Sicily.

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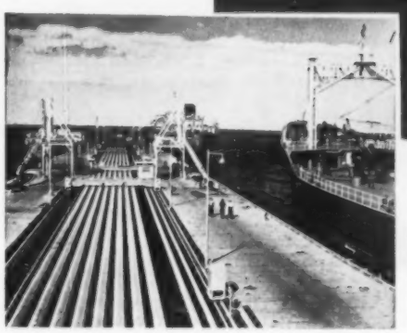

Kuwait Jetty at Mina-al-Ahmadi which was protected by "Guardion" Galvanic Anodes.

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New Company Formed For Swiss Exploration

A new Swiss company is being formed for oil and gas exploration in Switzerland. The name is SEAG (Aktiengesellschaft für Schweizerisches Erdoel).

The company was registered in St. Gallen, November 12, 1956, with a capital of six million Swiss francs, of which 20% has been paid in. A number of top Swiss industrial companies are shareholders. The German oil company, Elwerath (a shareholder) will handle the actual exploration—with some Swiss exports. Informed sources say it will be some time before operations begin.

The Petroleum Prospecting and Exploitation Agreement for Switzerland now is in effect. It has been approved by the cantons of Zürich, Bern, Solothurn, St. Gallen, Aargau, and Thurgau, and the Swiss federal council.

To Drill At Tambo, Queensland

South Pacific Pty. Ltd. has been formed to drill on 7,000 square miles of concession near Tambo, Queensland. The capital investment is $200,000, which may be increased another $100,000, if needed. The capital is Australian and American. R. R. Herring, Houston, is president, and J. L. Hargrove, vice president. Plans are to drill one or two wells; and, if no commercial-sized deposit is found, to dissolve the company. Offices are at Brisbane. A local driller is to be used.

Government Controls Sumatra Fields

North Sumatra oil fields remain under government control, exercised by the Ministry of Economic Affairs, under government regulation No. 34, approved by the President on December 26, 1956.

Portuguese Crude Imports Rise 7%

Crude-oil imports to Portugal climbed by 7% in 1956, to 1,298,000 metric tons, over the year before.

Imports of gasoline were down 15%, and of fuel oil down 11%.

Here are figures on imports of bulk petroleum products, by country of origin, into Portugal:

PORTUGUESE IMPORTS BY COUNTRY OF ORIGIN—1956

(Thousands of Metric Tons)

From:	*1955*	*1956*	*Change (%)*
Iraq	667	629	—38
Curacao	239	209	—38
Saudi Arabia	235	307	+72
Iran	58	21	—37
Venezuela	44	95	+51
Other	25	37	+12
	1,268	1,298	+30

Here are imports of bulk petroleum products to Portugal, by product:

PORTUGUESE IMPORTS BY PRODUCTS—1956

(Thousands of Metric Tons)

Product	*1955*	*1956*	*Change (%)*
Crude oil	910	976	+66
Kerosine	55	55	—
Gasoline	40	34	— 6
Fuel oil	263	233	—30
	1,268	1,298	+30

Kuwait Producing 850,000 B/D

Kuwait crude-oil exports were 26,422,260 bbl during January of this year. Distillate exports were 109,712 bbl. This was from Kuwait Oil Co. Crude exports from the Neutral Zone came to 424,575 bbl from American Oil Co., and 704,915 bbl from Getty Oil Co. Kuwait crude exports were 25% lower than in January a year ago, and 2% above December's 23,800,000 bbl.

Eire To Make Oil Search

The government of Eire is considering the proposal of an interested group to make a complete oil survey of all of Eire. Its decision is based on a 12-month preliminary geological search. The negotiations begun last year for test drilling for oil and gas in various areas of West Clare are continuing.

Kuwait Drilling Continued

Following discovery of oil in 1955, in Raudatain No. 1 well, a second well at Raudatain was spudded in December 1955, at a spot approximately two miles southeast of the discovery. The second well was drilled to 9,695 ft, and 7-in. casing cemented at 8,778 ft. Production facilities are not yet available in this area, and so the well was closed in during July 1956. Further exploratory drilling is being carried out.

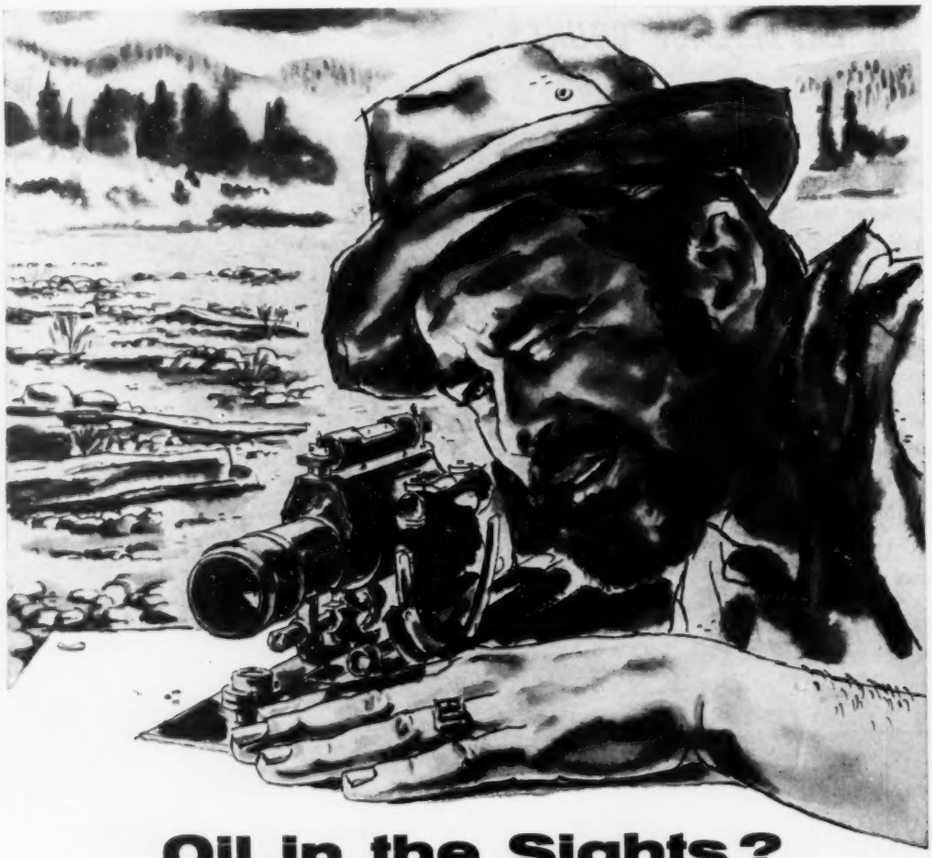
Another well, Sabruja No. 1, has been drilled at a new location, about nine miles southeast of Raudatain No. 1, to 8,450 ft. Seven-inch casing was cemented in at 8,459 ft. It is intended to deepen the well to explore the Zubair sands.

A test well was drilled at Bahra, about 10½ miles south of Sabruja No. 1 and six miles from the site where the first test well, Bahra No. 1, was drilled in 1936-37 and abandoned as a dry hole. This Bahra No. 2 well, a producer, has been drilled to 8,488 ft with 7-in. casing cemented at 7,789 ft. The well has now been closed in, awaiting production facilities.

It would appear Kuwait Oil Co. has a major new field in these discoveries.

By the end of 1956, 211 wells had been drilled and put in production. In 1956, 2,603 tankers were loaded at Nina-al-Ahmadi. This number is less than the 2,715 loaded in 1955, but it is accounted for by the greater average size of tankers loaded, as all tankers in service of over 38,000 dwt tons were loaded there.

Preparations are in hand to increase the capacity of the refinery from 1.4 million tons per year to 8.5 million tons. This work commenced in mid-1956, and is expected to be completed by the beginning of 1958.



Oil in the Sights?

Mapping outcrops in the foothills, this geologist helps to bring closer another oil discovery in Western Canada. His work is important to the oil exploration team and to Canada because by 1980 the demand for Canadian Petroleum is expected to triple.

An important part of the oil man's team is the Petroleum and Natural Gas Department maintained by The Canadian Bank of Commerce at Calgary. This Department is staffed by men who *know* the oil industry. Their expert knowledge, backed by detailed and complete records of exploration and development, is available in Calgary, or can be obtained for you by any of our branches across Canada.

We invite you to call in and see this Department when you're in Calgary. For maps and other information write to: C. H. Munro, Manager, Petroleum & Natural Gas Department, 309-8th Avenue West, Calgary.

(The Bank does not advise on the merits of oil or mining securities)

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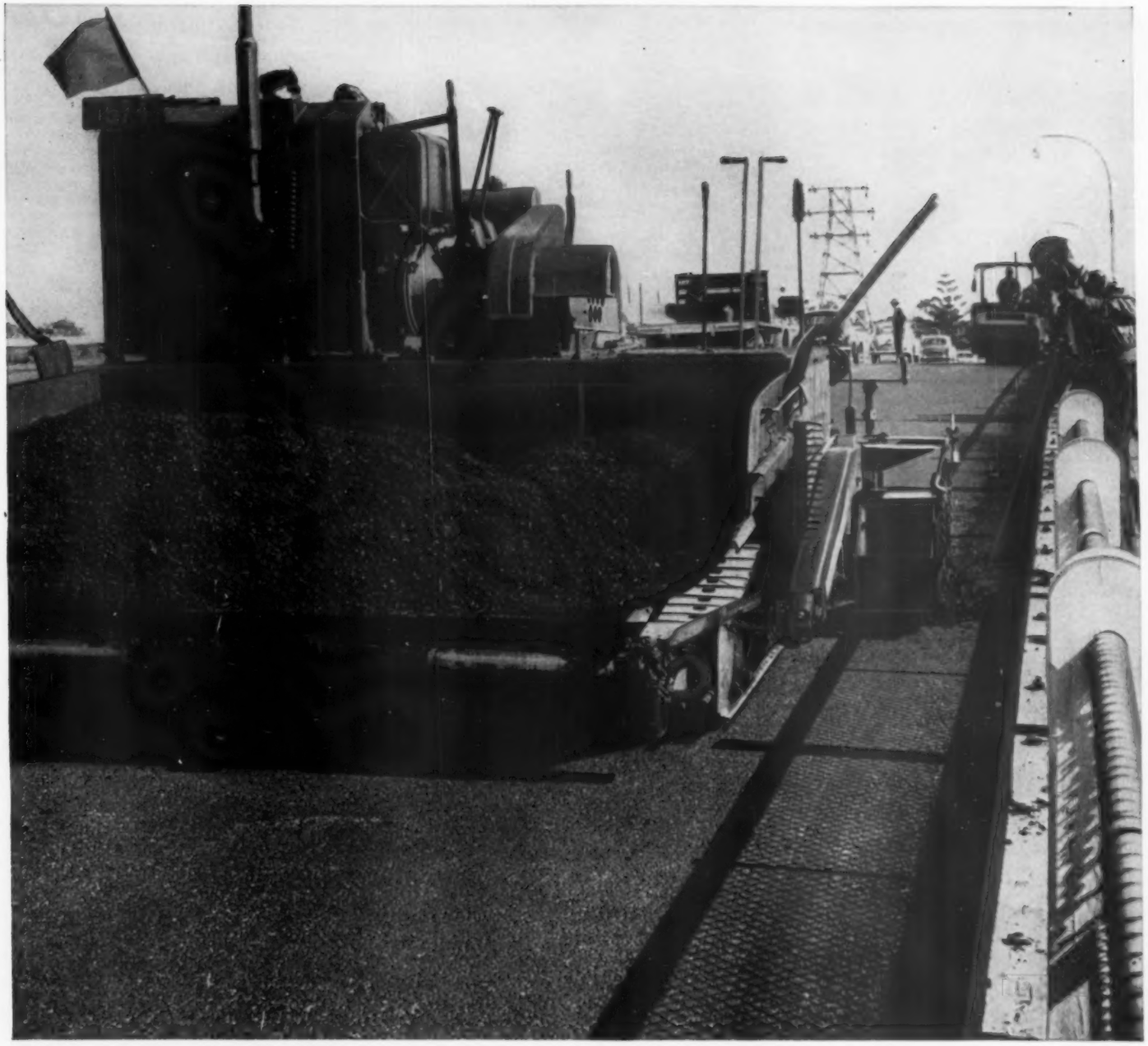

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London Letter

By E. Lawson Lomax

Strikes in shipping and engineering industries have reduced fuel consumption also. From the government's view, the gasoline situation is easier. Value of coupons for the next period has been increased by 50%, a coupon now having the value of 1½ gal.

The increased duty of 1/- per gal, imposed when rationing was instituted, was expected to bring in £25 million, but this barely balances the loss due to reduced sales under rationing. It is evidently policy to keep the extra tax on as long as the government possibly can, and thus effect a certain amount of rationing by cost to the purchaser.

Rationing is far from welcomed by the refining industry. The most important petroleum product is residual fuel oil and, to make more of this, more crude oil must be distilled, which in its turn means the production of more gasoline. Refiners have to compromise in one way or another, either by the production of an excess of gasoline or the production of a shortage of fuel. At the present time the tendency seems to be the production of as much fuel oil as convenient, and to look with an easy eye on the use of rationing coupons for gasoline purchase.

Major companies, after consultation with the Ministry of Power, have raised the costs of all fuel oils, ranging from ½d per gal in the case of aviation spirits, to 1¼d per gal in the case of gas-diesel oils. In the case of motor gasoline, the retail price is increased by ¾d plus ¼d on the dealer's margin, making a total increase of one penny per gallon.

Oil Meeting in London

On March 18, leading executives of Standard Oil Co. (New Jersey), Socony Mobil Co. Inc., Standard Oil Co. of California, Gulf Corp., The Texas Co., Compagnie Francaise de Petroles, The British Petroleum Co. Ltd., and Royal Dutch-Shell group met in London at Shell-Mex House to discuss the problems connected with transport of Middle East crudes.

The conference, which was exploratory, probably discussed the problems of the various methods of transporting Middle Eastern crude in the light of the recent crisis, together with the natural expansion of production in this quarter during the next decade. No findings of the conference have been published.

UK Gas Exploration

There are, as yet, no large known sources of natural gas in the UK, but exploration is actively being pushed by BP Exploration Co. Ltd. on behalf of the Gas Council. In order to supplement the manufacture of coal gas and conserve the use of coal for this purpose, the Gas Council has also entered into arrangements for the purchase of refinery gas from the Fawley refinery, Shellhaven refinery, and Kent refinery.

A contract has recently been given by the Southern Gas Board to Humphreys and Glasgow Ltd. for the erection of a reforming plant at Southampton Gas Works, and for a 17-mile pipeline to convey the petroleum gas produced at Fawley to the reforming plant. The reforming plant will consist of two sets of ONIA-GEFI catalytic plants of 8 mmcf capacity daily when working on refinery gas. The plants are built to the designs of Soc. de Construccion d'Appareille pour Gas de l'Eau et Gas industrielle. Alternatively, the plants can be used to gasify heavy oil—each plant then having a capacity of 4 mmcf per day.

The question of the utilization of gas burned at Middle East oil fields is also being considered. A large amount of experimental work has already been carried out. Preliminary results point out that, with a carefully worked-out-scheme of purification, i.e., desulurization, at source, and carrying out the project on a sufficiently large scale, the cost of delivery of the liquefied gas into the UK should work out at something of the order of 5 pence to 6 pence per therm, which would allow a big margin below the cost of coal gas.

New Measurement System

A new system of microwave measurement of distance, of considerable use to the petroleum industry, has been invented by a South African, T. L. Wadley, and has been introduced as the "Tellurometer" into the UK by Cook, Troughton & Sims, of London.

The new "Tellurometer" operates on the 10-cm wavelength region, and measures the transit of radio waves over the length to be determined, with an accuracy of a fraction of a millimicro-second. Measurements can be made by day or by night; and visibility, for the first time in the history of surveying, is immaterial. The range of the Tellurometer is at least 20 miles. It has an accuracy commensurate with that of geodetic triangulation, and is sufficiently simple of operation to be employed by people not versed in electronics. It is reportedly light, portable, and easily erected; of rugged construction and dependable; and can be used for long periods without undue problems of maintenance. It is versatile to the extent that it will fulfill its functions for all normal survey tasks under all reasonable meteorological and geographical conditions.

Ruston's Air-cooled Diesels

Ruston & Hornsby Ltd. recently placed a range of air-cooled diesels, ranging in one- and two-cylinder sizes from 4 to 12.5 bhp, on the market. These engines are basically similar to their comparable water-cooled series.

Before offering these engines for sale, the firm had 20 various sized prototypes made which were distributed among contracting and other industrial firms and subjected to severe operating conditions for 9 months. In all cases, the engines stood up to the work, without requiring anything other than running maintenance. These trials suggested slight modifications in design which have been embodied in the manufacturing range.

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—Eugene Holman, Chairman of the Board, Standard Oil Company (New Jersey)

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New Personnel Notes

James Alexander Lumsden MBE, of Maclay Murray & Spens, solicitors, has been appointed to the Weir group as of March 6, 1957.

George Edwards has been appointed automotive manager of the South Wales district.

Austin Kelly, naval architect for Vickers-Armstrong (Shipbuilders) Ltd., has retired. He became an apprentice at Sir W. G. Armstrong Whitworth's Elswich Shipyard in 1907, and at the end of his apprenticeship became a member of the design office. In 1930, he joined Vickers-Armstrong Naval Design Department at Walker Yard, and later in the same year went with it to Barrow. He was awarded the MBE for his work on various designs for naval vessels during the war; was appointed naval architect to the shipbuilding company in 1953; and made a special director in 1955. He was closely connected with all the large supertankers built by the firm.

Walter Harold Senneck, director of G.P. Wakefield & Co. Ltd., died at sea on March 23 while returning from a business trip to Australia. Mr. Senneck was 66, and joined Wakefields over 50 years ago—being made joint managing director in 1938, which position he held until 1951, when he resigned from it but remaining a director until his death.

A. L. King, until recently general manager administration has been appointed general manager sales on the retirement of W. A. M. Mackintosh, who has agreed to take over coordinating duties within the Shell-Mex and BP group of companies.

Oil Storage Increase at Avonmouth

Esso Petroleum Co. Ltd. will shortly commence an expansion scheme at Avonmouth. The present expansion scheme will be located on a new 30-acre site at Holesmouth, to be acquired from the Port of Bristol Authority. It consists of storage tanks connected by pipeline to the existing ocean terminal at Avonmouth. The estimated cost of the new scheme is £1.5 million ($4.2 million).

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J. M. Storey

UK Delegation to Visit Canada

A mission, sponsored by the Council of British Manufacturers of Petroleum Equipment—representing more than 400 engineering firms supplying the oil industry in the UK and abroad, and led by J. M. Storey, managing director of Dewrance and Co. Ltd., valve manufacturers—is due to arrive in Canada in May. It will cross from east to west, visiting all important oil installations and companies in the dominion. The commission will be in Canada for approximately three weeks, and will report results on its return.

Factory Equipment Exhibition

An exhibition to be held in May will have stands of 23 of the leading oil-burning-equipment manufacturers, grouped around a central two-storied stand housing the display of Shell-Mex and BP Ltd.

Tanker News

Now under discussion is building of the first merchant vessel to be driven by nuclear power—following the appointment of Rear-Admiral G.A.M. Wilson as Deputy-Engineer-in-Chief (nuclear propulsion). A committee embodying members of the Admiralty, the Merchant Navy, and shipbuilders has been formed especially to study the matter. It is probable that the vessel to be built will be an oil tanker. Design of such a vessel, with its propulsion unit aft, is the most suitable for the installation of atomic power; also the tanker to be built will be one of at least 80,000 dwt. It has been suggested that the design and building of the power unit will be financed by the government, and the building of the hull will be financed by the shipbuilding and oil industries—probably the latter.

A. G. "Weser," Bremen, has announced that the 36,040 dwt steam-turbine tanker "Esso Guildford," built by them to the order of the Esso Petroleum Co. Ltd., was launched from its yard, March 28, 1957. The vessel has a speed of 17 knots, and her cargo pumps can discharge crude oil at the rate of 4,350 tons per hour.

Harland & Wolf, Belfast, has announced an alteration to the Esso Petroleum Co.'s oil tanker "Esso Glasgow." This tanker was built in 1944 as a single-screw turbo-electric oil tanker, a standard T-2 type, and formerly called "Waumatchie." Her original cargo tank section was cut out at the above yard and replaced by a newly built one which was launched March 14, 1957.

Societe Maritime des Petroles BP (Shipping subsidiary of BP's French associate, Societe Francaise des Petroles BP) has ordered two new tankers of 47,670 dwt each, and one of 68,500 dwt, from Ateliers et Chantiers de France, at Dunkirk, for delivery in 1960, 1961, and 1963.

John I. Jacobs—the tanker owners, brokers, and managers—report increase of net profits from £216,000 in 1955 to £308,000 in 1956; 15% dividend was paid, and on capital distribution of 12.5% free of tax.

SPECIAL-PURPOSE REFINERY UNITS

The world-wide Fraser Contracting Organisation offers a complete service for the design and construction of special purpose petroleum refinery plant. Recent examples include the Solvents Distillation Unit at ESSO Ocean Terminal, Purfleet, Essex (illustrated), the Autofining Plants at Llandarcy and Aden and The Platformate Splitter Units at Llandarcy and Isle of Grain, for the British Petroleum Co. Ltd.

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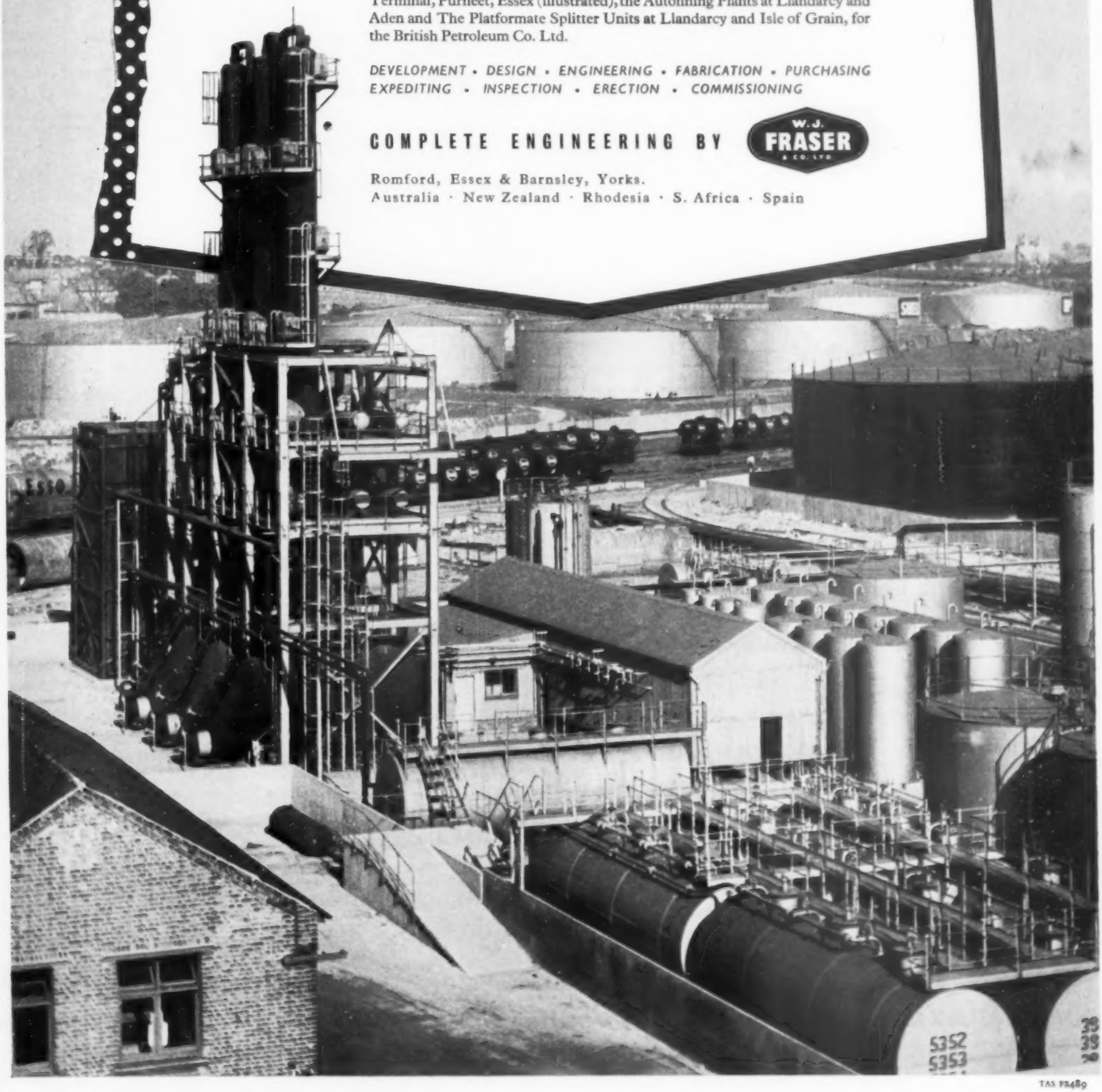

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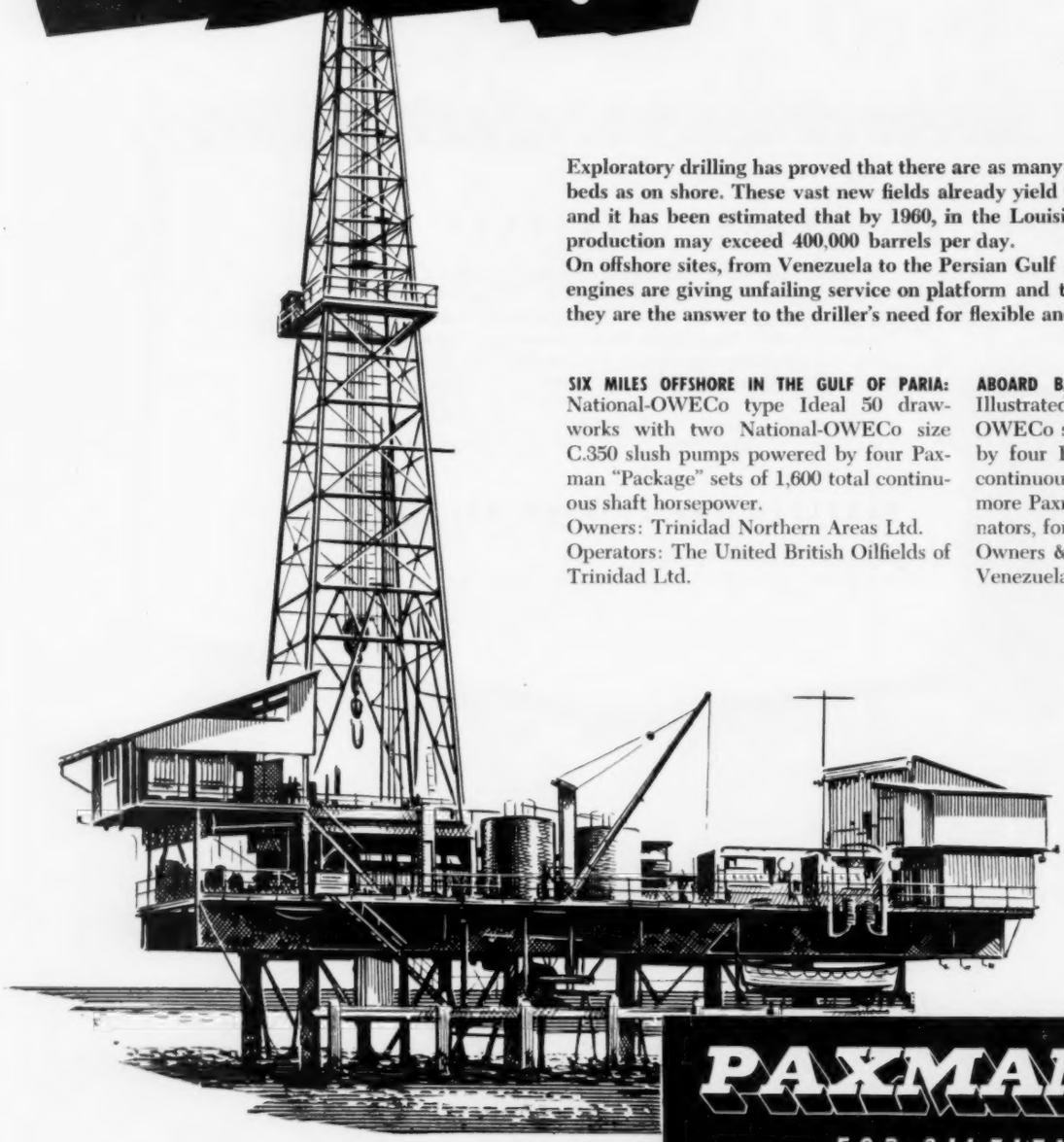
OFFSHORE...

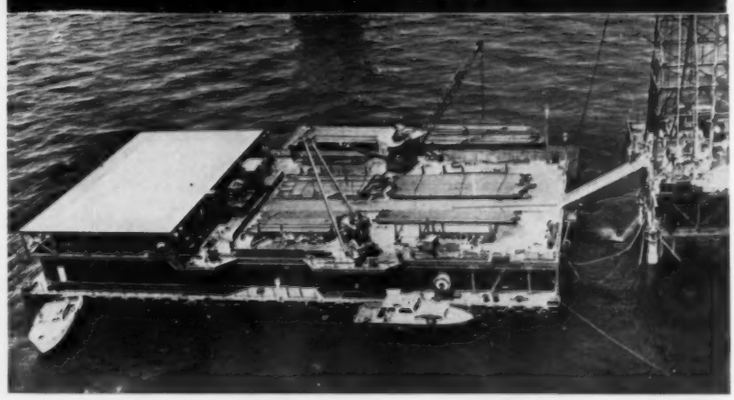


Exploratory drilling has proved that there are as many oil prospects beneath the ocean beds as on shore. These vast new fields already yield many thousands of barrels daily and it has been estimated that by 1960, in the Louisiana-Texas offshore areas alone, production may exceed 400,000 barrels per day.
On offshore sites, from Venezuela to the Persian Gulf and to Borneo, Paxman drilling engines are giving unfailing service on platform and tender, proving once again that they are the answer to the driller's need for flexible and dependable power.

SIX MILES OFFSHORE IN THE GULF OF PARIA: National-OWECo type Ideal 50 drawworks with two National-OWECo size C.350 slush pumps powered by four Paxman "Package" sets of 1,600 total continuous shaft horsepower.
Owners: Trinidad Northern Areas Ltd.
Operators: The United British Oilfields of Trinidad Ltd.

ABOARD BARGE G.P.5 ON LAKE MARACAIBO: Illustrated at foot of page, three National-OWECo size E.500 slush pumps powered by four Paxman "Package" sets of 1,468 continuous total shaft horsepower. Two more Paxman engines drive 250kVA alternators, for power and lighting.
Owners & Operators: Compania Shell de Venezuela.

PAXMAN DIESEL ENGINES FOR OILFIELD DUTY



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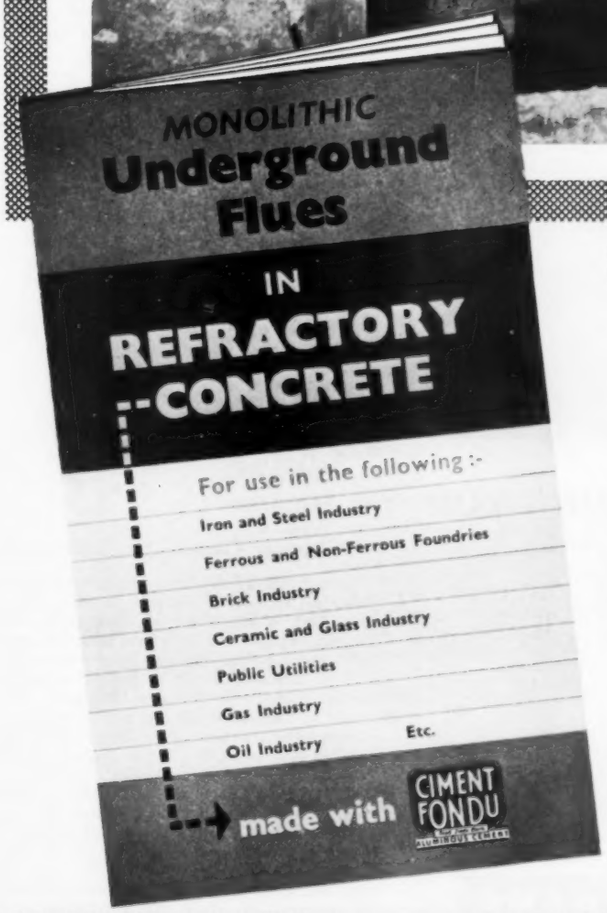
Refractory Concrete monolithic flue in course of construction. Note movable former centered in trench.



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Latin American Oil News

New Brazilian Refineries

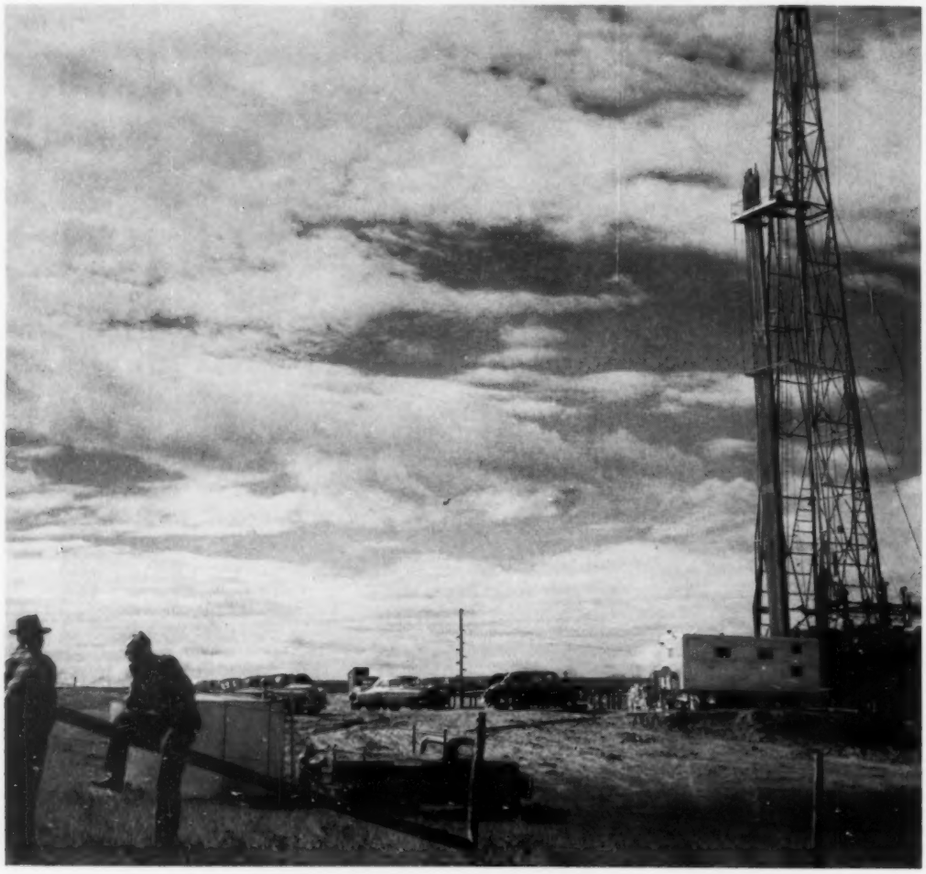
The projected 90,000 b/d refinery by Petrobras will be built by Universal Oil Products Co. in the municipality of Duque de Caxias, adjoining the Federal District, the Rio-Sao Paulo and Rio-Bahia roads, and the Leopoldina railway. Cost will be US $55 million. Construction should start in September 1957, and be completed within two years. Facilities will be installed to produce ethylene, styrene, benzine, butadiene, and synthetic rubber.

Colonel Nunes says Petrobras will start building a 25,000 b/d refinery in Minas Gerais in 1957-58.

Brazilian Oil Discovery

Oil was found on February 23 at wildcat No. 2-AZ, on Maraca Island in the Madeira River, at 8,898 ft. No. 2-AZ is about a half-mile distant from No. 1-AZ, where oil was discovered for the first time in the Amazon basin on March 13, 1955. The well is being lined, and drilling will continue to the crystalline rock to verify the existence of oil at lower levels.

Three new Cardwell drills reached Belem in January, and will be installed at Gurupa and Monte Alegre, in Para, and at Uatuman, in Amazonas.



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Waterford Drills First Nicaragua Well

Waterford Oil Co., New Orleans, La., holder of an oil exploration concession in Nicaragua, was to start drilling the first of six to eight wells in the country in February on the east coast.

The first well is to be started 25 miles offshore and 45 miles northeast of Puerto Cabezas on the Atlantic Coast. The first drill is to be in 6 ft of water adjacent to a drop of 70 ft. The company expected to sink 18-in. pipe to a depth of 4,000 ft. within 45 days. The company is equipped to go to 13,300 ft. Cost of the first well is estimated at $400,000 for exploration expense, and $850,000 for the well itself.

Waterford has sold 2/9 of its concession to Warren Petroleum Corp., which sold out for $600,000 to Gulf Oil Corp., but remains a Gulf subsidiary for refining and marketing purposes. Waterford sold another 2/9 to J. Ray McDermott & Co., New Orleans, La., which is believed to be majority-owned by Waterford. Waterford has 5/9.

Roger Wilson, McDermott vice president, says the geology is similar to that of the Williston Basin. Company officials estimate the dome runs 1,400 ft to 2,000 ft.

Brazilians To Develop Bolivia

Seven Brazilian firms have submitted offers to exploit oil in the area ceded to Brazil by Bolivia under the 1938 agreement. President Kubitscheck suggests they form one or more groups to strengthen their financial position. Brazil's proposals were forwarded to the Bolivian government on February 26.

Venezuela Drilled 1,414 Wells In 1956

A total of 1,414 oil and gas wells were drilled in Venezuela during 1956, according to reports to Washington from US officials in Caracas. The Shell group drilled the most, 465 wells. Then came Mene Grande, with 353; and Creole with 166. Breakdown follows:

VENEZUELAN WELLS DRILLED IN 1956

	OIL		*GAS*		*DRY*		
	Development	*Wildcats*	*Development*	*Wildcats*	*Development*	*Wildcats*	*TOTAL WELLS*
Creole	134	9			9	14	166
Mene Grande	298	23	1	2	18	11	353
Shell group	436	6			16	7	465
Sinclair	41	7			4	6	58
Texas	30	2			4	3	39
Las Mercedes	32	5	1		12	19	69
Socony	61				1		62
Atlantic	15	6			2	8	31
Phillips	41		3	1	1	2	48
Richmond	81				3		84
Pantepec	2				1		3
Talon	24				12		36
	1,195	58	5	3	83	70	1,414

Sinclair Caracas Staff Expanded

As a result of its expanding production and refining activities in Venezuela, Sinclair Oil and Refining Co., a subsidiary of Venezuelan Petroleum Co., has expanded its executive staff in Caracas. The following personnel changes have been made:

E. T. Lincoln, formerly general superintendent stationed at Santa Barbara, Monagas, has transferred to Caracas to fill the newly created position of executive assistant. W. C. Summy, formerly production superintendent, Santa Barbara district, has become general superintendent in charge of all drilling and production. Carmen R. Apt was promoted to assistant superintendent in the Santa Barbara district. He has been chief engineer and in charge of the gas and gas-products plant there. H. I. Liechty, formerly assistant to Mr. Apt, becomes chief engineer. Valentine E. Burnett, electrician at the gas-products plant, has transferred to Barinas as district electrician and supervisor, garage and transportation.

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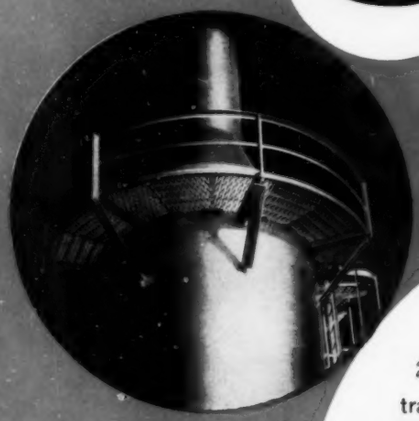

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Andes Oil In Bolivia

Andes Oil Co. has applied fro eight exploitation concessions under the Bolivian pertoleum code. The areas are in Zone I, and total 498,709 hectares (about 13 million acres) in Cordillera province in the Deparment of Santa Cruz. Expectations are that the application, uncontested, will be approved. Andes reportedly represents Standard Oil Co. (Ohio), Hancock Oil Co., and Pure Oil Co. Officials of all three firms were in Bolivia last November.

Pemex To Obtain French Loan

Mexico's nationalized petroleum industry, Petroleos Mexicanos (PEMEX), long suffering from lack of investment capital, may come up with a favorable long-term loan. A group of private French banking interests have offered PEMEX a loan of $200 million. The offer is said to be about $134 million in cash to carry out an exploration and development program and $66 million worth of refinery and oil-field equipment to be purchased in France. It is understood that a large part of the payment for the financing program will be covered by crude-oil shipments to France.

Meanwhile, PEMEX officials disclosed that the recently developed San Andres field in the northner part of the state of Vera Cruz, is now producing 10,000 b/d of 32-gravity oil, with nine wells in operation. San Andres has been developed slowly, because it is Mexico's first major deep field —with all wells being at below 10,000 ft. Twelve drillings rigs are working in the area, and an additional three are being moved in. It is predicted about 50 or 60 wells will be in operation by the end of the year, and that San Andres, when fully developed, will be one of the nation's largest oil fields.

New Venezuelan Well

The Atlantic Refining Co. and the Pancostal Petroleum Co. have announced the completion of their Caro No. 1 on the San Jose de Guanipa concession, as an offset to the recently completed Sinclair Aguassay No. 3 discovery well in the state of Monagas, Venezuela.

Drilled to a total depth of 13,647 ft, the well was dually-completed with a total flow of 1,185 b/d through ¼-in. chokes, with oil gravities ranging between 30 and 35. Perforations were at 13,403 ft to 13,415 ft and 13,322 ft to 13,340 ft. A lower zone at 13,579 ft to 13,597 ft was also tested and produced 30.5 gravity oil.

A depth of over 8,000 ft has already been reached in the drilling of Caro No. 2, with total depth projected to about 13,500 ft. Atlantic and Pancoastal jointly hold approximately 13,500 acres in this area.

Cataract To Explore In Panama

Cataract Mining Corp., of New York, has announced it will spend approximately $1 million in exploration in the Chiriqui area on Panama's Pacific coast. In addition, it has announced an agreement with Compania Petrolifera de Chorcha SA for the exploration by Cataract of an additional 52,000 acres on a concession held by the Panamanian corporation.

SSC Transfers

MICHAEL W. TYRRELL will lead a gravity party of seven men to Bolivia. The six others include John W. Chovin, gravity computer; Frederick W. Doll, Robert S. Plumb, and Robert C. Oberg, gravity surveyors; Clinton W. Brownell, gravity-meter operator; and Herbert E. Smith, gravity mechanic.

The five men transferred to the Brazilian crews include Party Chief Anthony J. Kochendorfer; Richard W. Dunbar, observing supervisor; Charles G. Laird and Philip A. Rehil, observers; and R. W. Ivey, driller.

20,000 B/D Texas Co. Refinery To Cost $15 Million

The Texas Co. (West Indies) Ltd. has a target date of June 1957 to complete an oil refinery at Santiago, Cuba, but may not make it. The plant is to have a capacity of 20,000 b/d and to cost about $15 million. The word came as the Cuban government offered additional benefits toward the project in Decree 62.

Mexico To Expand Chemicals

Mexico's infant chemical industry will expand during 1957. Montrose Mexicana SA, associated with the Montrose Chemical Corp. of California, will begin immediate construction on a new $4 million chemical plant at Salamanca, state of Guanjuato. Machinery and equipment will be both of USA and French manufacture, and will be installed under the supervision of US Montrose technician.

Corbu Industrial de Mexico will soon start construction on a $½ million chemical plant at Hidalgo, state of Michoacan. The Hercules Powder Co. owns 60% of the new company, and the rest of the capital was furnished by Nacional Financiera, official agency of the government. The plant, which is expected to be in production late this year, will manufacture trementine and by products.

Favors Private Petrochemical Industry

The National Petroleum Council of Brazil has adopted a resolution advocating private participation in the petrochemical industry, but favoring government participation if private capital does not do the job adequately.

New Brazil Well

Petrobras has high hopes for a pilot well being drilled at Taboleiro de Martins, in Alagoas, Brazil. Drilling began January 18.

Haney and Williams Drilling Co., Los Angeles, is doing the work under contract. Fifteen American technicians are on the job, training Brazilians. Later, a well is to be drilled in River Jequia area.

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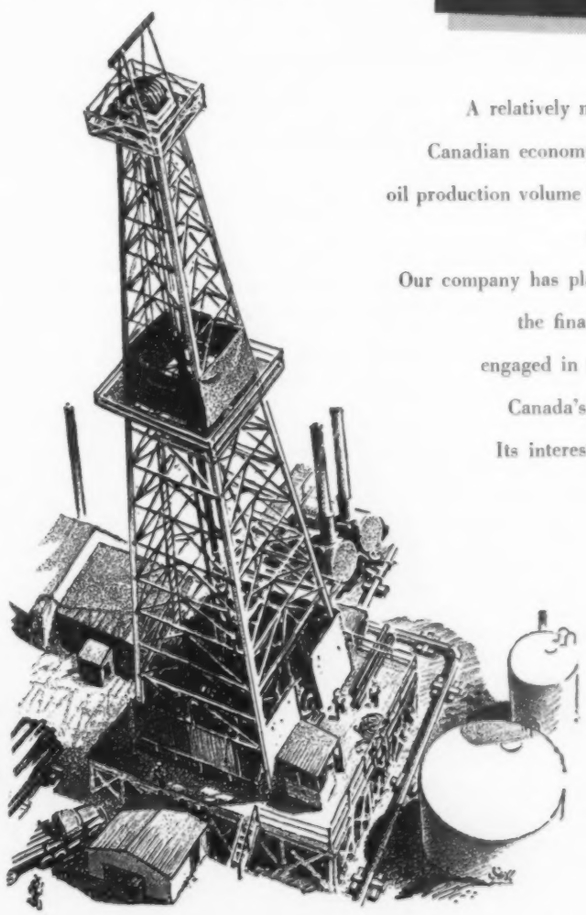

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Conservation and the New Conservation Act in Alberta

by D. E. Lewis

D. E. LEWIS was graduated in 1941 by the University of Alberta, from which he holds BA and LL.B. degrees. In the same year he joined the Canadian Army. After service abroad, he returned to Canada in 1946, but retained his army affiliation. He is now a lieutenant colonel, commanding the Calgary Highlanders.

Within the framework of the Canadian Petroleum Assn., Mr. Lewis has served on a number of committees—particularly the Legal Committee, of which he was chairman from 1955-56 and currently is a member. He has been a member of the council of governing bodies of the Canadian Bar Assn., and presently is a council member ex-officio. *Mr. Lewis also is co-author of the comprehensive three-volume legal work entitled* Canadian Oil and Gas.

Mr. Lewis joined Imperial Oil Ltd.'s Producing Department in 1948, as a solicitor, and presently holds the position of regional solicitor for Imperial.

Using a broad base of experience drawn from six years of operation and observation, Alberta has passed a new conservation act. Fundamental changes in the new Act are expected to improve its performance.

CANADA has had the experiences of the United States to draw upon in formulating conservation measures. Like the leading American oil states, its production of oil and gas is regulated from discovery to market. The provisions of the new Alberta Oil and Conservation Act may be considered a summary of modern conservation practices. It is also an example of the excellent co-operation which can be achieved between government and industry.

There were conservation measures enumerated in various Alberta acts as early as 1938; however, a consolidation was made, and new ideas added, in 1949 and 1950 to form the Oil and Gas Conservation Act, 1950. This act was the result of the need for more complete conservation because of the rapid growth of the oil and gas industry after the discovery of the Leduc field in 1947 and the Redwater field a year or so later. At that time the government, besides its own experts, called upon the services of an outstanding American oil and gas conservation lawyer as well as well known oil and gas men in Canada for the benefit of their experience in the drafting of that act. The final bill included a number of ideas from the Model Act of the Interstate Oil Compact Commission—with peculiarities of Canadian law, engineering, and local practices superimposed. Experiences in the ensuing six years have pointed out certain weaknesses in the act, and during the current session of the Alberta legislature a new bill evolved which, it is hoped, will correct a number of weak points. A number of conferences were held between industry, the Conservation Board, and the government respecting the act and the new form. The Canadian Petroleum Assn., representing industry, event went so far as to have representatives visit extensively in various representative oil and gas areas in the United States to view and study first-hand practices therein of the legislative bodies, administrative boards, and operators. The result of all these meetings results in an act which represents aggressive thinking, cooperation, and experience.

In order to appreciate the jurisdictional powers of a provincial government and the reasons why the province, rather than the dominion or federal government, has the power to pass legislation, we must examine the governments of Canada and point out generally how they differ from those of the United States, as it is only by understanding the difference is it possible to appreciate the real significance and scope of the new conservation act.

The government of Canada is that of a federation comprised of a central government with authority over matters of general and common interest, and of provincial governments with authority over matters of local concern. The division of legislative powers between the central authority and the component states or provinces is found in The British North America Act. Sect. 91 to 95 lay out the main divisions. In Sect. 92, certain classes of subjects are enumerated, and the province is given exclusive power to make laws in relation to matters coming within these classes of subjects. These classes include such things as the administration of justice; municipal institutions; the establishment and maintenance of prisons, hospitals, asylums, and charitable institutions; and control over the public land of the province. The provinces were also given control over local works and undertakings. An exception reserves international interprovincial lines of transport and communication to the dominion, and also authorizes the dominion to take legislative jurisdiction over any local work at any time by declaring it to be for the general advantage of Canada or for the advantage of two or more provinces.

Among the classes of subjects also named in Sec. 92 as powers of the province are two vague or general references, i.e., property and civil rights in the province and generally all matters of a merely local or pri-

vate nature in the province. These latter two subjects by judicial interpretation over the years have become of utmost importance. It is under them that a province has the right to legislate on oil and gas, including conservation.

The Ontario Court of Appeal expressed the powers a few years ago in the case Sandwich East v. Union Natural Gas Co. thus:

"A provincial legislature has the power to interfere with and destroy vested rights in property within the province, whether those rights are in respect of land or personalty, contractual or otherwise; in this power it can validly authorize others to exercise."

The opening paragraph of Sect. 91 of the British North America Act gives the dominion power to make laws for the peace, order, and good government of Canada in relation to all matters not coming within the class of subjects by the act assigned exclusively to the legislature of the province. The section then proceeds with the specific enumeration of 29 classes of subjects illustrating, but not restricting, the scope of the general words used. The enumeration includes subjects such as defense, criminal law, naturalization and aliens, and the postal system. It also includes the regulation of trade and commerce, fisheries, banking, currency and coinage, etc. If however, there is any conflict between any dominion legislation and that of a province, the dominion legislation takes preference. Because of the conflict in certain fields, the difficulty of interpreting the divisions has caused complications in the past.

Within this general framework, the federal and provincial parliaments alike enjoy full sovereign powers. The governments may make or unmake at will any law touching upon any matters within its general competence. In effect, therefore, and speaking from a pure legal standpoint, the subject has no firm and immutable guarantee of life, liberty, or property excepting as may be embodied in historic precedent and convention. In this particular, our law differs materially from that of the United States. In view of the fact that most of the precedent of oil and gas comes from the United States, care has to be taken at all times to make certain that the distinction between the Canadian constitution and that of the United States is considered, and complete reliance cannot be placed on American legal precedents *per se*. This division of power explains in great part differences in the conservation statutes of Canada and the United States.

The objects of the new Alberta Conservation Act are materially the same as those of the 1950 act. They are now expressed as follows: (a) to effect the conservation of the oil and gas resources of the province; (b) to prevent the waste of the oil and gas resources of the province; (c) to secure the observance of safe and efficient practices in the locating, spacing, drilling, equipping, completing, reworking, testing, operating, and abandonment of wells and in all operations for the production of oil and gas; and (d) to afford to each owner the opportunity of obtaining his just and equitable share of the production of any pool.

These objects can only be fully appreciated with an understanding of the word "waste" which is defined in the act to mean: " 'waste,' in addition to its ordinary meaning, means 'waste' as that term is understood in the oil and gas industry, and includes the underground or surface loss through wasteful operations of oil or gas or of potentially recoverable oil or gas."

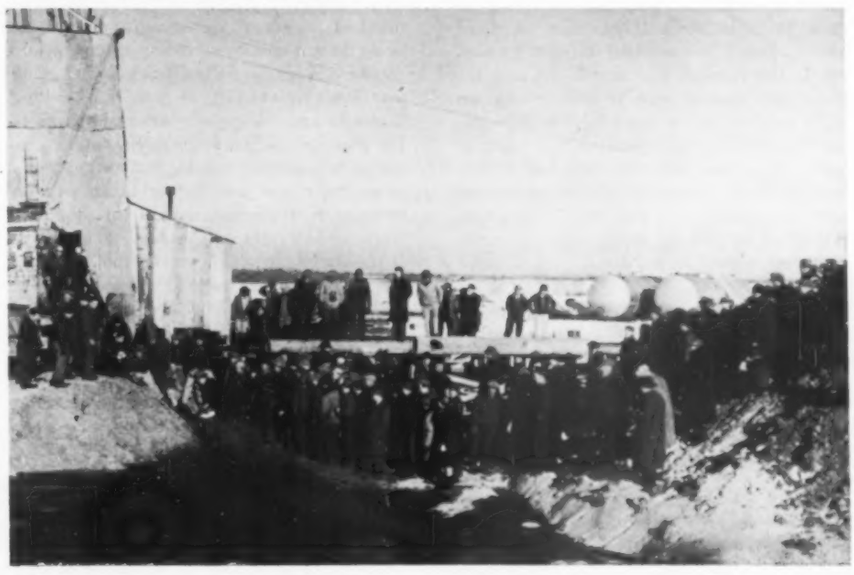
This is a much shorter definition than that used in any American statute. However, the words "wasteful operations" are defined in some length, and include all the things which in American statutes mean waste, and has some other clauses added. This represents one of the major changes from the former act and, because of its possible wide-reaching effect, it is desirable to set out the definition as follows:

" '*wasteful operations*' mean (i) the locating, spacing, drilling, equipping, completing, operating or producing of a well in a manner that results or tends to result in reducing the quantity of oil or gas ultimately recoverable from a pool under sound engineering and economic principles; (ii) the locating, drilling, equipping, completing, operating or producing of a well in a manner that causes or tends to cause excessive surface loss or destruction of oil or gas; (iii) the inefficient, excessive or improper use or dissipation of reservoir energy however cause; (iv) the failure to use suitable artificial, secondary or supplementary recovery methods in a pool where it appears probable, on the basis of available information, that such methods would result in increasing the quantity of oil or gas ultimately recoverable from the pool under sound engineering and economic principles; (v) the escape or the flaring of gas, if it is estimated that, in the public interest and under sound engineering principles and in the light of economics and the risk factor involved, the gas could be gathered, processed if necessary, and it or the products therefrom marketed, stored for future marketing, or beneficially injected into an underground reservoir; (vi) the inefficient storing of oil or gas, whether on the surface or underground; (vii) the production of oil or gas in excess of proper storage facilities or of transporation and marketing facilities or of market demand therefor; or (viii) the use of gas for purposes other than gas lift, repressuring, recycling, pressure maintenance or for light or as fuel, unless such use is beneficial, in the public interest and efficient."

Subsection (iv), (v), and (viii) are completely new, and probably more restrictive than formerly, but do express conservation practices in Canada during the past few years.

In order that the objects may be carried into effect, the act provides, as did the former, for its administration by a conservation board consisting of three members which is a body politic and corporate that is a separate entity free from political influence. Its whole purpose is to effect the conservation of the oil and gas resources of the province by the control or regulation of oil and gas, and this may be done by regulation or order, either generally or with respect to any special area or areas. These powers extend to well spacing, drilling, completion, abandonment, prorating both as to wells and to market demand. In addition to the specific powers, the board has added powers in the drilling and production regulations made pursuant to powers granted in the act. Some of its orders once formulated are issued and amended from time to time;

February 13, 1947, marked the start of Alberta's oil and conservation problems. Leduc No. 1 well came on production at that time and hundreds of spectators gathered to watch the drill crew turn the flow of drilling mud into the pit.



for instance, it issues field or pool outlines and proration allowables monthly or as it deems advisable.

The board is authorized and empowered to obtain the services of engineers, accountants, and other professional persons as it deems necessary for the proper and convenient transaction of its business.

It is quite clear from a reading of the details in the act and the present regulations (which will probably continue in effect) that the requirement of good engineering practices in drilling and production be followed will continue to dominate the board's activities. Complete records must be kept and made available to the board or its officers, and, within limits, to industry.

The board is authorized and empowered to make from time to time such inquiries and investigations into production, transportation, and distribution of petroleum and natural gas as it deems advisable. These powers have been exercised quite frequently in the past, and it is expected that such will continue to be the fact in the future. For instance, the board has called public hearings to inquire into the formulae used in determining its MPR or MER; the export of gas, which necessitates a permit from the government under the Gas Resources Preservation Act; spacing units; the granting of allowables; and the like. In Canada, as a result of a lack of a written constitution like that of the United States, a public hearing or any hearing is not granted as a matter of right, but only where a court or board has statutory power or custom requires one. In this respect, the present board has been very generous and fair in the establishment and conduct of hearings.

The board has power, with the approval of the Lieutenant Governor in Council, to declare the proprietor of a pipeline to be a common carrier, or a purchaser of oil or gas to be a common purchaser in a pool or field. It is unlikely that either of these powers would be exercised without a hearing. In this respect, a section in the new act gives any person who is affected by an order or direction of the board made without the holding of a hearing the right to apply for a hearing if he applied within forty-five (45) days after the effective date; and the board has the power to vary, amend, or rescind the order formerly made as it may almost any order.

It is also the duty and the responsibility of the board to enforce all the orders made pursuant to the Oil and Gas Conservation Act. The integrity of the board as an independent tribunal is insured by its security of tenure of the members for five years after their respective appointments, during which time they can only be removed from office by impeachment in the Legislative Assembly. Tenure of office after five years is at the pleasure of the Lieutenant Governor in Council until reappointment. The cost of the board and its operations is paid for by both the provincial government and industry. A part of the act sets out how industry will be assessed and pay its share.

There are probably two other very significant changes in the new act over that of the former. The first deals with pooling and unit operations, and the second deals with the right of appeal.

Formerly there was no power given to the board to enforce pooling or unit operations or unitization. Under the provisions of the new act, an owner of a tract within a spacing unit may apply to the board for an order that all tracts within a spacing unit be operated as a unit to permit the drilling for or the production of oil or gas from a spacing unit. If production is found, the board has the right to inflict a penalty on the owner who refused to agree to voluntary inclusion, so that the maximum he will have to pay will be up to one and one-half of the share of the cost of the drilling on the basis of the share of production allocated to the tract. In the case of a dry hole, the person requesting the order has to pay full costs.

The provisions dealing with unit operation in a field or pool, or what is more commonly referred to as the unitization sections, follows more the Oklahoma statute than that presently found in the neighboring province of Saskatchewan. In Alberta, if the owners in a pool cannot agree upon a plan of unitization, 50% of the working-interest owners calculated upon an acreage basis may apply to the board to have the pool operated as a unit. The board has the right, if it so desires, however, to hear an application of less than 50%. If it is shown that the operation as a unit would prevent waste and inefficient operation of the field, pool or part thereof, the board, with the approval of the Lieutenant Governor in Council, may order that the pool be operated as a unit. The act outlines a number of things which the order must set out such as date of commencement, legal description of lands included, allocation of production to each tract, adjustments to be made, payment of expenses, the establishment of an operations committee, voting interests and voting, etc. However, the order cannot come into force unless 75% of both the working interests and the royalty interests agree to the plan. In the province of Saskatchewan, no such provision exists, and the government there has jurisdiction to enforce an order without any concurrence of either the working interests or the royalty interests. It is only fair to say, however, that an order has never been made in Saskatchewan without a hearing by the Conservation Board of all interested parties, and the board only has jurisdiction if the unit is necessary to prevent waste and will increase the recovery and result in general advantage to the owners within the pool. The unit operation or unitization sections of the Alberta act will only become effective when proclaimed by the government, whereas the rest of the act will be effective July 1, 1957.

The right of appeal, as stated, is of significance. The former Alberta act stated that every action, decision, or order of the board with respect to any matter or question was final and conclusive, and was not open to question or review in any court. This meant that anything which was within the competence of the board to adjudicate upon could not be questioned except by the use of prerogative writs in appropriate cases. In the new act, provision is made for limited appeals to the courts, but the subjects of appeal are of utmost importance.

In the operative sections of the act, the board has considerable powers over schemes for pressure maintenance, processing of gas and the disposal of water as well as control over the owner of a gas line or operator of a processing plant. For instance, board approval is necessary to proceed with a pressure-maintenance scheme, or the owner of a gas line may be ordered to transport or deliver gas to such place or plant that the board directs. These powers, if improperly invoked, could involve large sums of money, and could result in uneconomic ventures which would be most unreasonable and against the public interest. Under the appeal section, orders of the board may be appealed to the courts on a number of grounds, including insufficient evidence, or lack of evidence, and the fact the order or direction was wrongly made. Questions respecting drilling and production or common-carrier or purchaser provisions are restricted in appeal to questions of jurisdiction or law. From an industry point of view, it is anticipated that these appeal features alone will be most beneficial in settling contentious points which hithertofore rested solely with the board.

Conservation acts, as such, with the exception of Alberta and Saskatchewan, have not been passed by the various provincial legislatures. Drilling and producing restrictions and other conservation practices there are generally affected by regulations under the appropriate Mines and Minerals Act or its equivalent. In all likelihood, as production increases, conservation acts as such will come into vogue—based, I would predict, on the new Alberta act.

The conservation act in Saskatchewan gives very similar control over the prevention of waste, engineering, unitization, pooling, drilling, producing, proration, etc., to that of Alberta; and, like Alberta, was based in great part upon American precedents, particularly the Interstate Oil and Gas Conservation Model Act—the major difference being that control is retained in the Department of Mineral Resources, and not in a conservation board as such. They have a conservation board which holds hearings, and its findings become recommendations for the consideration of the departmental officials. This means, of course, that there is closer direct political control over oil and gas development in Saskatchewan than in Alberta. However, relations between industry and the government appear to be good, and recent development in that province is indicative of cooperation which is similarly evidenced in all the oil and gas producing provinces. END

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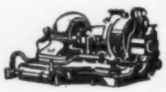

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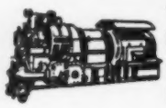

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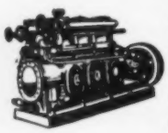

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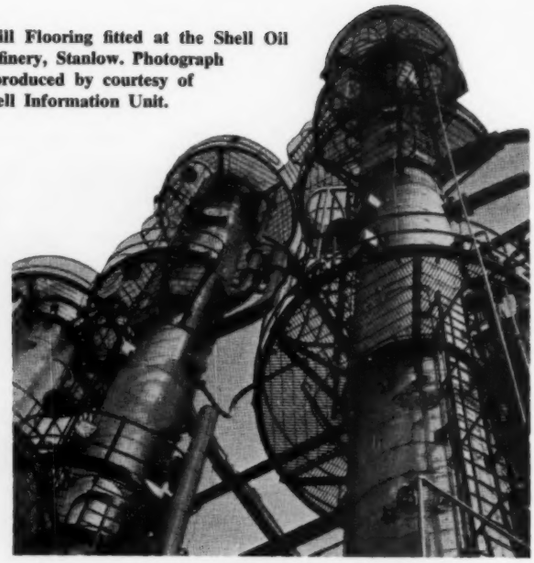
Grill Flooring fitted at the Shell Oil Refinery, Stanlow. Photograph reproduced by courtesy of Shell Information Unit.



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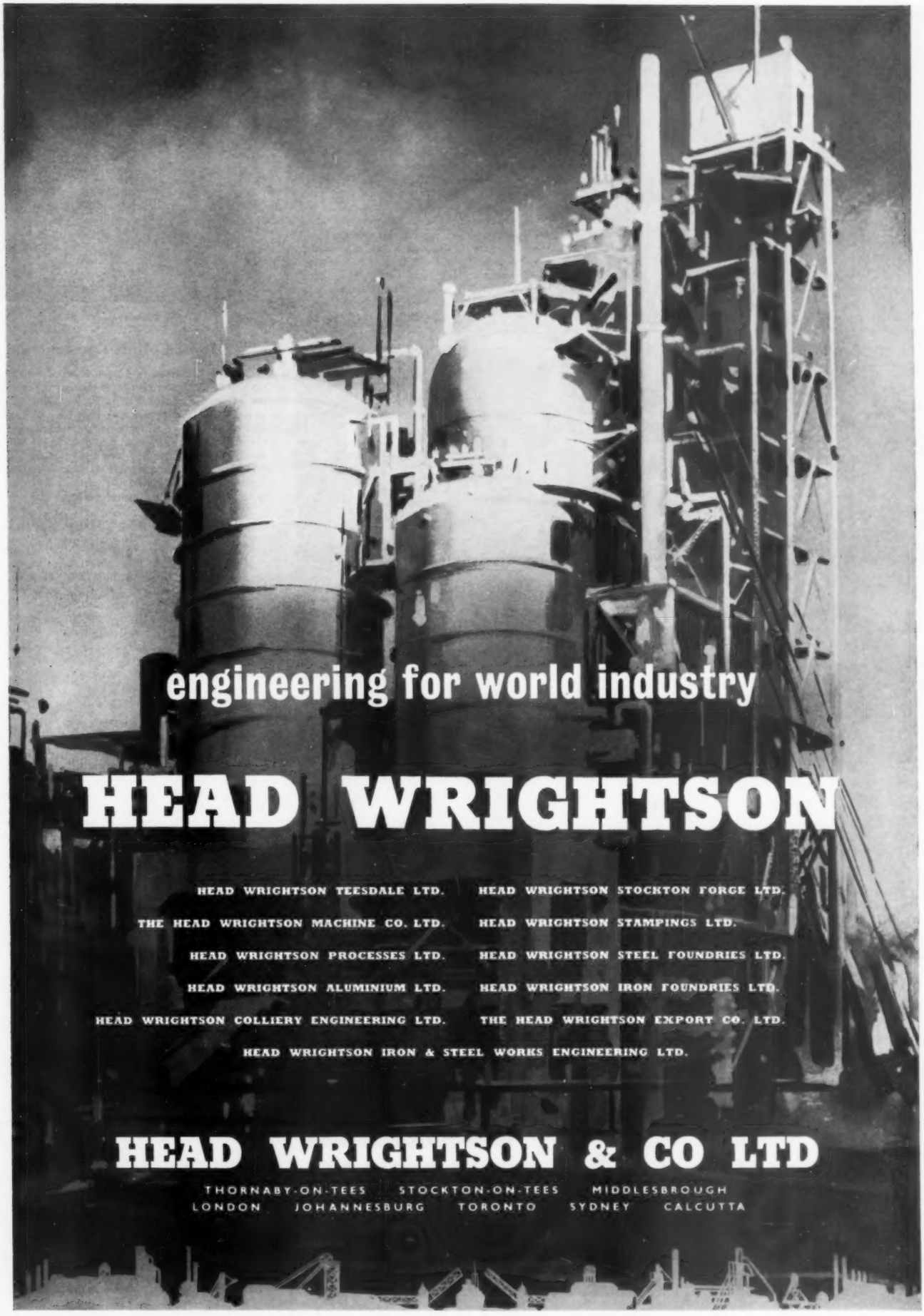
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Oil and Gas Provide 67½% USA Energy

Oil and gas furnished 67.5% of the energy used in the USA during 1956, according to a new calculation from the US Bureau of Mines. The rest came from bituminous coal, 26.8%; hard coal, 1.4%; and water power, 4.3%, the bureau said.

Crude oil supplied 39.8%, and the total was 2,903,447,000 bbl. Product imports gave another 1%. This is the highest total barrels in history, but the crude-oil percentage was as high as 40.8% in 1954.

Natural gas furnished 23.9% of the energy—some 9,773,246 million cubic feet. This is a record both in total volume and the percentage.

Bituminous coal and lignite furnished 26.8% of the energy—some 432,764,000 net tons—after a relatively good year in a long-term decline. Hard coal gave 1.4% of the energy—some 23,700,000 tons.

Water power accounted for 4.3% of the energy used.

Federal Regulatory Agencies Undesirable, Says White

J. R. White, Imperial Oil's president, believes creation in Canada of federal regulatory bodies resembling those in the USA "should give any Canadian concern" in regard to future economic progress. Referring to a recent suggestion to that effect, Mr. White said freedom from non-essential regulations and respect for contracts are of first importance in the creation of an atmosphere of confidence needed by Canadian industry.

"Confidence is the most precious national resource which governments have in their custody," he said. "Confidence in Canada's expanding economy has led to remarkable progress in the canadian oil industry," he said. It is estimated that capital expenditures over the next 25 years will average out to a billion dollars annually. When we look ahead at the next 10 years in the oil industry, we do so with some basis for feeling that Canadian industry can tackle successfully any foreseeable problems.

Claude F. Horton

Joins Collins Construction

Claude F. Horton has been elected executive vice president and a director of Construcciones Collins de Venezuela, according to S. V. "Sammy" Collins, president. Mr. Horton was also named assistant to Mr. Collins in contract negotiations for the Collins Construction Co. of Port Lavaca, Texas. Both firms specialize in submarine pipeline construction.

Active in construction since 1930, Mr. Horton was formerly vice president of Brown & Root Inc. in charge of all pipeline construction.

New Co-Op Marketing Facilities

Marketing facilities of Maple Leaf Petroleum Ltd. throughout Alberta have been purchased for approximately one million dollars by United Farmers of Alberta Co-operative Ltd. The 25,000-member co-op now will own and operate 125 agency outlets in Alberta. Involved in the purchase are the bulk petroleum storage plants of Maple Leaf Petroleum, its inventories, marketing equipment, and the use of Maple Leaf trade brands. UFA formerly had acted as distributing agent for Maple Leaf products.

Record Oil Expenditure in BC

Mines Minister Kenneth Kiernan has reported to the legislature of British Columbia that more than $20 million will be spent in that province during 1957 in the search for oil and natural gas. This activity will be centered primarily in the Peace River area of BC, where 98 gas and 11 oil wells have been completed to date. The Peace River area is capable of producing 500 million cubic feet of gas per day. Exploration expenditures during the past six years in BC total more than $56 million.

Regina Gas Contract Signed

The contract for the construction of the natural-gas distribution system for Regina has been awarded to the Pacific Pipeline Construction (Alberta) Ltd. and S E Construction (Alberta) Ltd. Under the contract, the commencement date of construction is May 1, with the completion date for the laying and testing of all mains set for September 1. Contract price for contractor's labor cost only, including the supplying of equipment, is $1,726,185.28. The SPC is to supply all necessary material, pipe, etc., plus engineering and inspection services.

Saskatchewan Oil & Gas Division Changes and Promotions

Dr. A. D. Cumming has been promoted to the new position of chief geologist of the Geology Division, Saskatchewan Petroleum and Natural Gas Department, according to announcement of the Honorable J. H. Brookelbank, the department's minister.

D. R. Francis has been promoted to principal geologist, reservoir section; Dr. J. G. C. M. Fuller, to principal geologist, research section; and H. B. Sawatzky, to principal geophysicist, geophysical section—all under Dr. Cumming.

A. J. Williams has been promoted to the new position of chief engineer, reservoir section; A. M. Babington, to principal reservoir engineer; and D. D. Barkwell, to senior reservoir engineer—both under Mr. Williams.

CANADA

New Industrial horizons are opening in the Canadian West with Edmonton the focal point.

Industrial and commercial development in the Edmonton area during the past decade has topped the $500,000,000 mark and continues at a steadily increasing rate.

Abundant natural gas from the fields surrounding Edmonton does double duty as fuel for low-cost power and a source of raw materials for growing petro-chemical industries.

Secondary industries using primary products and by-products of petro-chemical processes find Edmonton a sound economic location and provide further, healthy diversification to the city's economy.

Expanding, prosperous, local markets and a dominant position in the agricultural economy of the province make Edmonton an important distribution centre. One-half the entire population of the province lives within 100 miles of Edmonton.

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A WORLD-WIDE PAINT ORGANISATION

Washington Pipe Line

(Continued from page 4)

attention for years—and actively for the past year. Assuming a veto—and this is not positive—this does not automatically kill the bill. There could conceivably be a two-thirds vote in the House and Senate to override the President. Also, there's an outside chance of a compromise in the measure, which would make it palatable to the White House.

The measure, probably, has won more time and attention of oil-company executives than any piece of legislation so far in this session of Congress. Major oil companies, independent refiners, and oil jobbers all are opposed. On the other hand, the National Congress of Petroleum Retailers is vigorously for the measure. At present, an oil company selling gasoline to dealers must charge the same price to all in a competitive area—except that it may give a special price to one dealer, alone, to meet competition. The proposed law would cancel that exception. At the marketing end of the oil business, this is seen as a major antitrust matter.

Esso Standard Oil Co. wants more "speed and vigor" in enforcement of gasoline price-discrimination laws. E. B. Paust, general counsel, put this on the record in a letter to Senator Estes Kefauver (D., Tenn.), chairman of a Senate Judiciary Subcommittee. Mr. Paust argued against S. 11, the "good faith" pricing bill, saying, "specifically what the Robinson-Patman act needs is enforcement, not amendment." He reviewed a gasoline price war in Portsmouth, Va., and its effect on gasoline dealers in Norfolk, Va., across the James River.

Canada-Midwest Line Up for FPC Hearings

Proposals to bring a pipeline of Canadian natural gas to the USA Midwest come up for hearings before an examiner for the Federal Power Commission, starting May 14. Midwestern Gas Transmission Co. is seeking to bring in 204,000 mcf daily of gas from Trans-Canada Pipe Lines Ltd., at the border near Emerson, Manitoba. Midwestern would buy an equal amount of gas from Tennessee Gas Transmission Co., its parent, at Portland, Tenn., and run a line from Portland to Emerson.

The hearing, opening May 14, is complicated, as it is a consolidated proceeding in which nine pipeline companies have filed 20 applications. At least three of the companies propose projects competitive with Midwestern's. The three are Michigan Wisconsin Pipe Line Co., Northern Natural Gas Co., and Natural Gas Pipeline Co. of America. Other companies proposing new gas facilities and service in the proceeding are American Louisiana Pipe Line Co., El Paso Natural Gas Co., Permian Basin Pipeline Co., Iron Ranges Natural Gas Co. Months are ahead before a decision.

Oil-for-Europe Statistics Available

Printed copies of the oil-for-Europe hearings by subcommittees of the Senate under Senator Joseph C. O'Mahoney (D., Wyo.) promise to be a best seller. The printed copies, and appendix volumes, contain a wealth of statistical material about oil-company production, revenues, taxes, etc.—much of it never made available before. Copies are free—while they last.

Depletion Allowance Under Fire

The income-tax depletion allowance for crude petroleum and natural-gas production may be headed for more trouble—despite Senate refusal to tamper with it during March. Debating proposals to slash the allowance, Senator Clinton Anderson (D., N. Mex.), generally a friend of depletion, asked a full study of depletion for oil and for all minerals. He said Secretary of the Treasury George Humphrey is for this too. Some say Mr. Anderson is out for a higher allowance for uranium—now at 23%, while oil and gas get 27.5%. Further, Senator John A. Carroll (D., Colo.) called for ending the depletion for USA oil companies which operate abroad—claiming they need no incentive. He forecast a Senate report on the oil-for-Europe program will call for ending the allowance in these fields.

Whether ending the allowance on oil firms abroad would mean much is debated. With US income-tax rates at 52%, and foreign governments taking 50% of the profits, many say the depletion is not needed to lower the tax bill. Any moneys paid in foreign income taxes reduce the tax bill due the USA by the exact amount of those payments. Some economists claim, however, that it is not that simple; that a depletion credit for foreign operations does help substantially to cut down on the tax bill due the USA. Oil men claim, further, that foreign operations, too, need the incentive of the depletion.

The assaults on the depletion came from Senator John Williams (R., Del.), who proposed, in a tax measure, to slash the allowance to 20%. He said this would add $200 million a year to USA tax revenues.

Senator Paul Douglas (D., Ill.) proposed to a sliding depletion—to allow 27.5% to operators with $1 million of income, moving down to 15% for the $5 million and more operators. Both the Williams and Douglas measures were voted down, and there was no roll-call vote.

President Eisenhower and the US Congress must approve, but if they do, here's the kind of natural-gas bill agreed upon by producers, pipeline companies, and distributors. Independent producers of gas, now under strict controls, could sell gas in and near the wells without permission of the government, and also operate close-in pipelines, and gathering and purifying facilities.

In existing contracts, present prices—including fixed-price increases by step escalations—would be approved. Also, favored-nation clauses would be accepted, if they met a "reasonable market price" test of the Federal Power Commission. In new contracts to sell gas, there could be no favored-nation clauses. The new contracts could contain "indefinite escalation clauses" such as those based on cost of living, but only if they met a "reasonable market-price" test by the FPC. The fixed prices would be subject to FPC review only once, when filed. After that, they are not to be challenged by FPC. If the FPC rejects a price, the producer has the right to refuse to sell.

All in all, the measure means more control than in the Harris-Fullbright bill which the President vetoed last year. Since then, the President has called for gas legislation, to clear up matters, and gas men have been urging him to take leadership in the fight for a gas bill.

THE PACE QUICKENS...

This year marks another important forward step for Canada's oil and gas industry. Canadian production now supplies 60 percent of our present oil consumption of 620,000 barrels daily.

With greater pipeline capacities, larger oil and gas reserves, increased markets, this important industry will play an ever increasing role in the Canadian economy.

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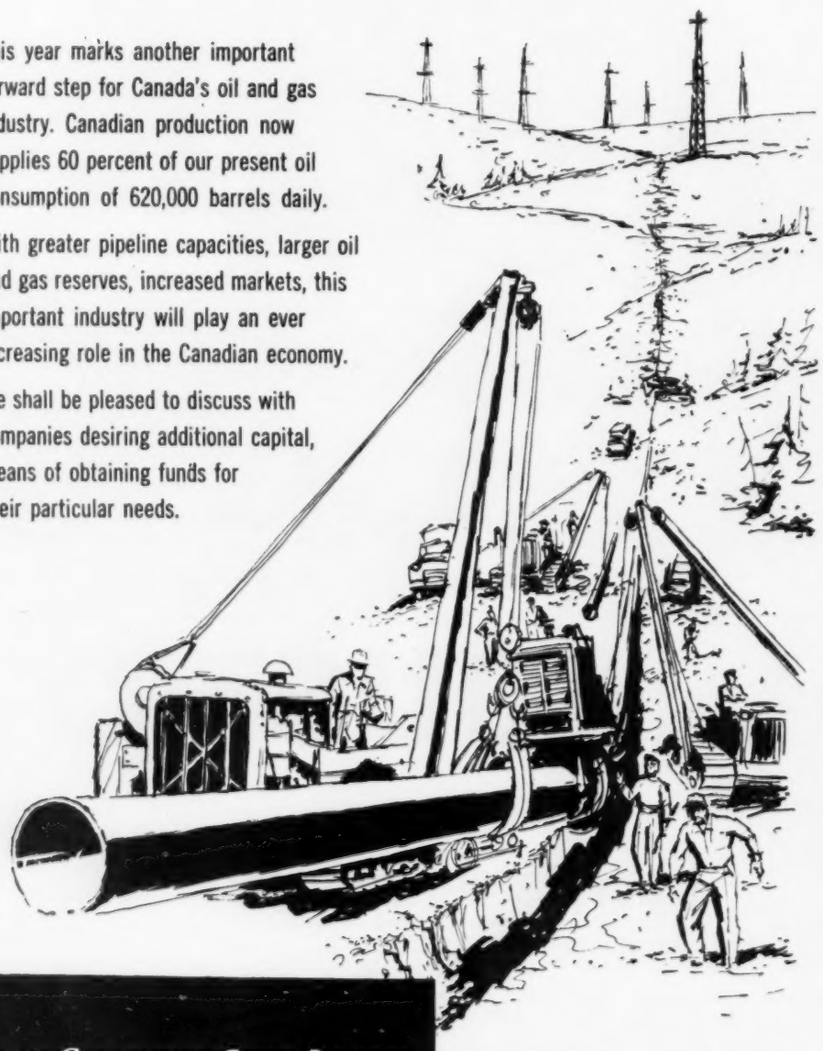

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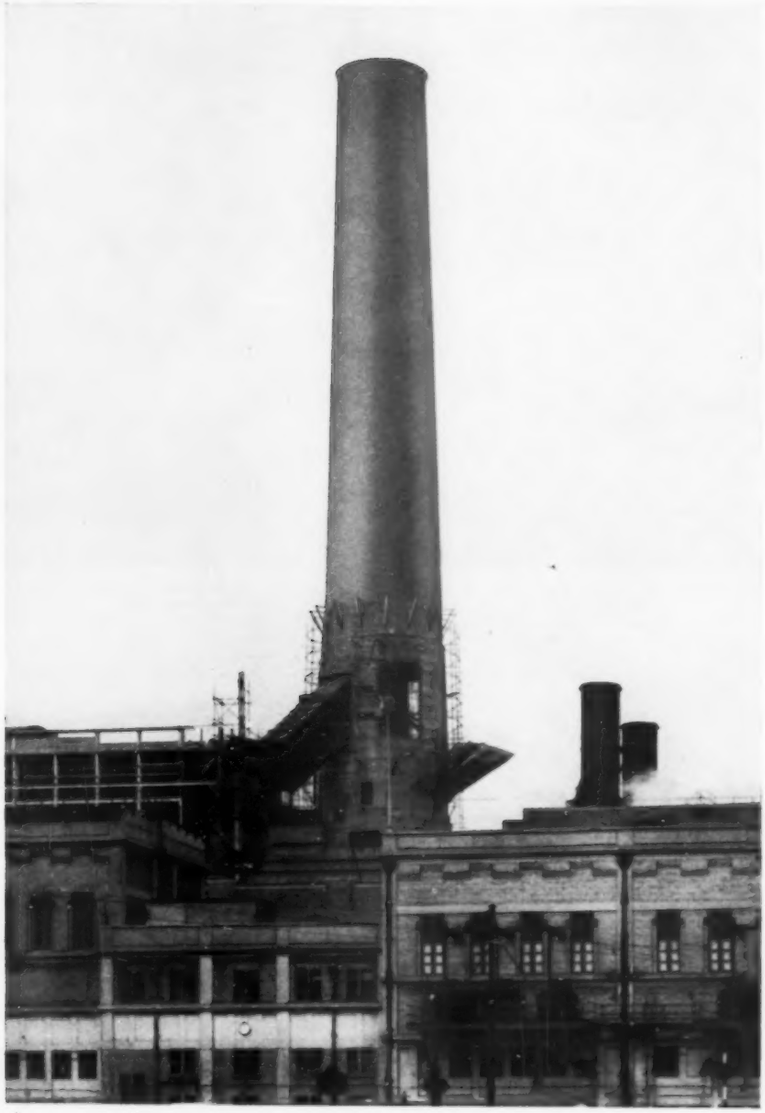

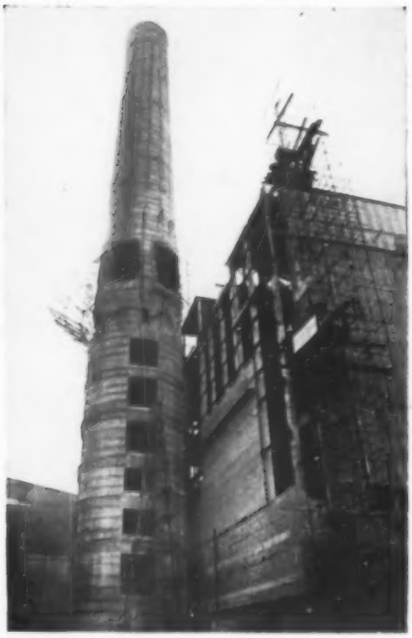

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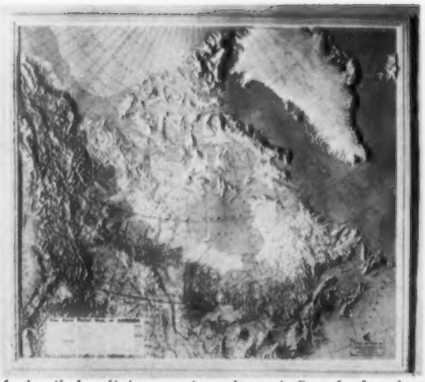


A detailed relief map, in color, of Canada has been compiled which shows the surface characteristics of the Canadian oil scene in a better way than anything to date. It is demountable, or comes already mounted and ready to hang, available through the well-known Aero Service Corp., 210 East Courtland St., Philadelphia 20, Pa.

To Extend Saskatchewan Pipelines

The Saskatchewan Department of Mineral Resources accepted submissions on route and designs, until March 15, for a proposed new pipeline extension to serve the province's Carnduff and Glen Ewen oil fields. Under plans disclosed by Producers Pipelines Ltd., a Saskatchewan company, controlled by oil companies operating in the southeastern section of the province, would construct 12-in. and 8-in. extensions from the existing Westspur pipeline's terminal at Alida, Saskatchewan. A 20-mile 12-in. trunk line and 34 miles of gathering lines have been proposed. The project has been approved in principle by the department, and a permit for construction is expected to be issued this spring.

Texas Instruments Sales Rise 59%

Texas Instruments 1956 sales rose 59% above previous record in 1955, to $45.7 million. After-tax earnings of $2,349,103 also set a new record, and net income per share of common stock was up 44%—to 72 cents from 50 cents. TI President J. E. Jonsson, in the annual report, predicted 1957 sales may reach $65 million. He estimated 1957 after-tax earnings at about a dollar per share.

To Report on USA Refinery Capacity

At the request of the Division of Oil and Gas of the Department of the Interior, the National Petroleum Council has appointed a committee to study and report on USA refinery capacity, as of January 1, 1957. The committee will study anticipated increases in capacity resulting from facilities now under construction or those which have been announced; also crude-oil throughput capacity, thermal and catalytic reforming, hydrogenation, and alkylation—by principal refinery areas.

NPC Chairman Walter S. Hallanan has announced chairman of the refinery study committee is Clyde T. Foster, president, The Standard Oil Co. (Ohio), Cleveland. Other members include Robert O. Anderson, president, Malco Refineries, Inc., Roswell, N. Mex.; Jacob Blaustein, president, American Trading & Petroleum Corp., Baltimore; Reid Brazell, president, Leonard Refineries Inc. Alma, Mich. (also president, WPRA); Bruce K. Brown, president, Petroleum Chemicals Inc., New Orleans; Rainey Elliott, Jones & Laughlin Supply Division, and president of Petroleum Equipment Suppliers Assn., Tulsa; George T. Goggin, Douglas Oil Co. of California, and president of Independent Refiners Assn. of California, Paramount, Calif.; George B. Hunter, Quaker State Oil Refining Corp., and president, National Petroleum Assn.; W. W. Keeler, Phillips Petroleum Co., Bartlesville, and chairman of the Military Petroleum Advisory Board; M. J. Rathbone, president, Standard Oil Co. (N.J.), New York; M. H. Robineau, president, The Frontier Refining Co., Denver, and president of Independent Refiners Assn. of America; Roland V. Rodman, president, Anderson-Prichard Oil Corp., Oklahoma City; Reese H. Taylor, chairman, Union Oil Co. of California, Los Angeles; and Dr. Robert E. Wilson, chairman, Standard Oil Co. (Indiana), Chicago.

Another NPC committee will study the availability of liquefied petroleum gases.

Reece Hatchitt, president of Dresser AG who recently left for Europe heads the foreign operations of Dresser Industries Inc., with headquarters in Zurich. To promote foreign sales Dresser has compiled a consolidated catalog of equipment manufactured by Dresser. The catalog also was published as an advertisement in World Petroleum Report—probably the largest single advertisement ever to appear in an oil publication. Shown above, left to right, are M. Stephens Miranda, director of advertising and public relations for Dresser, Mr. Hatchitt, and Gordon H. Barrows, editor of World Petroleum Report.

Dresser Sets $100 Million International Sales Goal for 1959

J. B. O'Connor, president, recently announced the election of Reece Hatchitt to the presidency of Dresser AG, European affiliate. Dresser Industries Inc. is one of the nation's leading manufacturers and suppliers of oil, gas, chemical, and electronic equipment, and technical services.

Dresser's foreign business rose from $11 million in 1950 to approximately $50 million in 1956, and this segment of the firm's business now represents approximately 22% of the firm's total annual sales of $230 million in 1955.

Mr. O'Connor also announced the election of Dr. Hans Berger of Zurich, Switzerland, who has been president of Dresser AG since its original formation in 1952, to chairman of the board of Dresser AG. In this capacity, Dr. Berger will remain with Dresser AG in an active executive position, working closely with Hatchitt in the firm's expanding overseas operations.

Dresser AG operates throughout Europe, and has grown steadily in sales, licensing, and manufacturing importance in step with Dresser's overall expansion of its foreign business generally. "These activities have become so extensive," Mr. O'Connor stated, "that the resident management requires additional executive personnel qualified to supervise its many licensees, sales and servicing companies, sales representatives, and manufacturing subsidiaries. Because of Mr. Hatchitt's long association with Dresser's overseas activities and previous foreign experience before joining Dresser, his appointment will serve to strengthen and broaden Dresser AG's executive staff in Europe. Every effort is being made to continue to provide our many foreign customers with top-quality products and services, in addition to supplying sales engineers, technicians, and other trained specialists conversant with the worldwide needs of the oil, gas, chemical, electronic, public-utilities, and other industries served by us in the Europan area," Mr. O'Connor said.

Reece Hatchitt has been closely associated with Dresser's foreign affairs for several years, originally as a member of the corporation's legal staff and subsequently as director of foreign operations, in which position he will continue to function in addition to his recent election. Prior to his affiliation with Dresser, Mr. Hatchitt resided in Chile, and has worked in specialized foreign sales and other consulting assignments. He holds a law degree from the University of Michigan and a BA from Dartmouth, and has an outstanding record of achievements in the foreign business field.

WILLIAM G. SKELLY

William G. Skelly, 78, chairman of Skelly Oil Co. died at Tulsa on April 10 after an illness of several months. He was active as the president and principal administrative officer of the company until shortly before his death. His passing removes one of the last of the early day independent operators in the Mid-Continent who built large companies from modest beginnings.

Mr. Skelly's father was a teamster in the Pennsylvania oil fields and Bill got his start in oil as a tool dresser. Later he worked for an oil well supply company and served as a private in the Spanish American War.

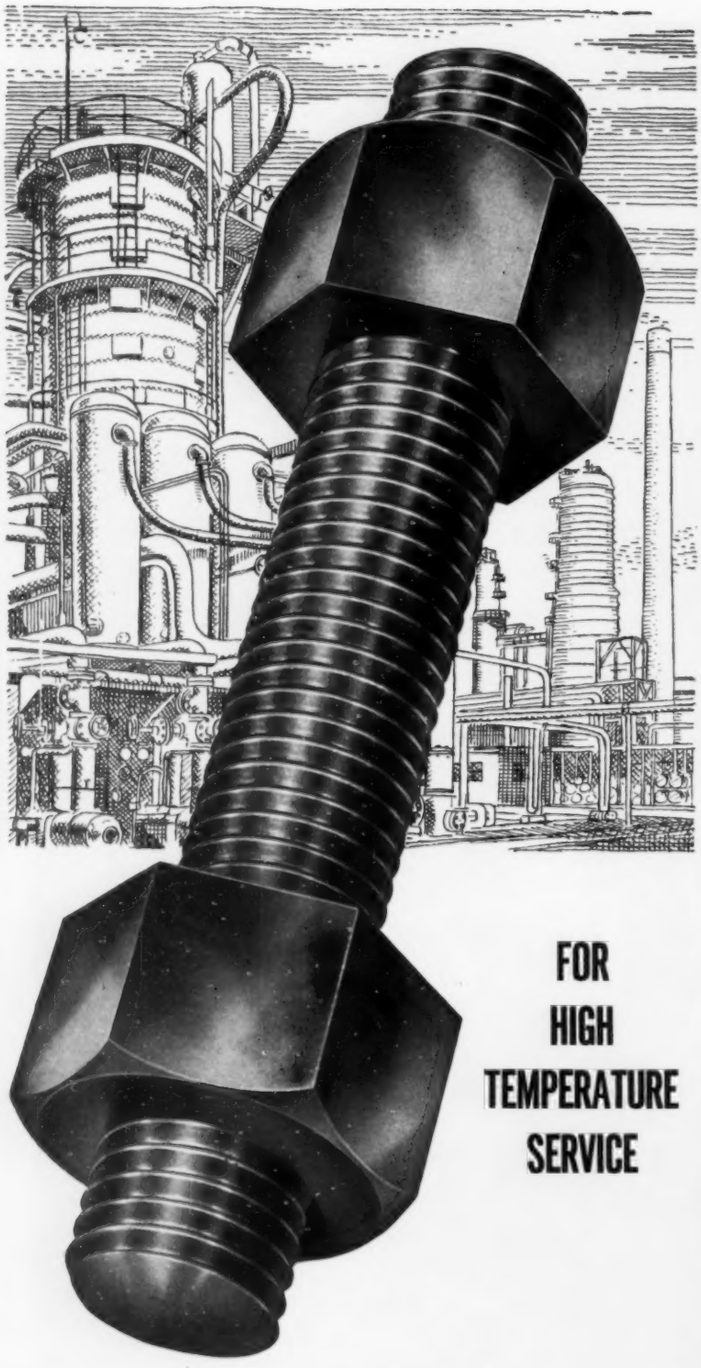
Moving west with the industry Mr. Skelly came to Tulsa in 1912 and in 1917 organized the Midland Refining Co. at El Dorado, Kansas. This became the nucleus of Skelly Oil Co. which now has assets of $399 million.

Mr. Skelly was widely known in the Southwest for his extracurricular activities in politics, religion and civic affairs. He was active in the Republican party as Oklahoma National committeeman. He was president for many years of the International Petroleum Exposition. He fostered agricultural and aviation activities and operated a powerful radio and television station.

G. STEWART BROWN

G. Stewart Brown, manager of the public-relations department of Standard Oil Co. of California, died recently. He had been in ill health for several months. A veteran newsman and public-relations executive, he was prominent in petroleum-industry affairs, serving as head of the nationwide Oil Industry Information Committee in 1955. He had been head of Standard of California's Public Relations Department since 1948.

IN CANADA: DIKKERS, LTD., SCARBOROUGH, ONTARIO



FOR HIGH TEMPERATURE SERVICE

Conforming to B.S.S. 1750-1951, Stud Bolts and Nuts are being supplied by Rubery Owen to all the principal Oil Companies and Refinery Equipment Manufacturers in ever increasing quantities. Special production facilities have been planned to suit every requirement to both British and American Standards with either Unified or Whitworth Threads.

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STUD BOLTS AND NUTS

RUBERY, OWEN & CO., LTD., BOLT & NUT DIVISION,
P.O. BOX 10, DARLASTON, WEDNESBURY, STAFFS., ENGLAND

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"ATLASITE" IS WIDELY USED IN THE LARGEST OIL REFINERIES IN CANADA FOR HOT-FACE TEMPERATURES TO 1000° F.

Rugged, efficient "Atlasite" can be easily removed and re-applied without damage. Basically it is Amosite fibre which is peculiarly well suited to give maximum insulation. "Atlasite" is also widely used throughout Canadian Industrial Plants. Pipe, block and sheet forms in standard sizes and thicknesses and to order in any special sizes required.

"Atlasite" is a worthy companion to Newall's 85% Magnesia and Newall's Newtempheit.

Atlas Asbestos is the only plant in Canada manufacturing a complete line of pipe and block insulation materials ranging from low to high temperatures.

ATLAS ASBESTOS Company Limited

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56-1

Trans-Canada Vice Presidents

N. E. Tanner, president of Trans-Canada Pipe Lines Ltd., announces the appointment of N. John McNeill as vice president and secretary; and Robert C. Berry as vice president and treasurer. Messrs. McNeill and Berry are located in the company's Toronto office.

Technical Information Division

Esso Research and Engineering Co., scientific affiliate of Standard Oil Co. (N. J.), has set up a special technical information division under the management of Charles E. Starr, Jr. William T. Knox is director of technical information; William M. Craig, public relations; Gordon Duncan, assistant director, technical information.

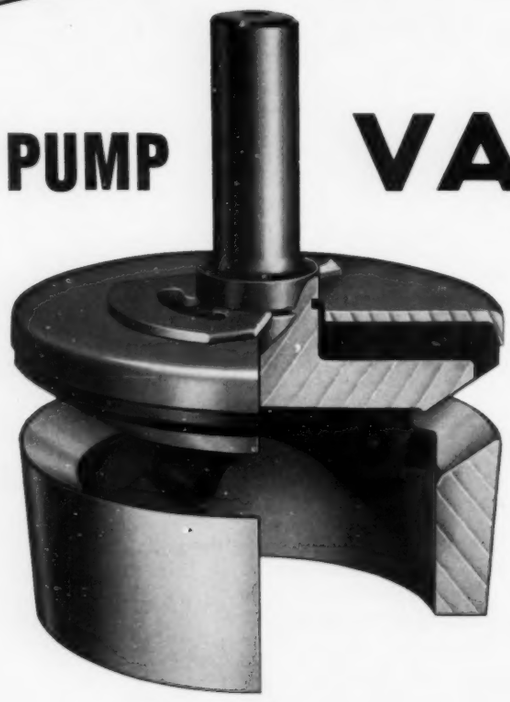
The new division will gather and distribute technical reports to Esso engineers and researchers.

Perforating Guns Atlas Corp. management conference brought visitors to Houston from domestic and foreign offices of PGAC.

A GREAT ADVANCEMENT

The SHIELDED INSERT

SLUSH PUMP VALVE



It is well known that oil based muds cause slush pump inserts to swell and distort. The E. & T. **Shielded Insert Valve** exposes only the sealing face to the drilling fluid. The rest of the insert is firmly covered and sealed in. It is held firmly in place by the patented **Shield.** The small exposed area is not sufficient for harmful swelling to occur.

Many users have found that E. & T. **Shielded Insert Valves outlast all others** and that the savings in "down time" due to fewer insert changes easily pays for the changeover.

Call Eason & Therolf or your favorite supply house today. Valves and Seats are supplied in **sizes to fit all makes and sizes of slush pumps.**

Eason & Therolf TOOL COMPANY

P. O. BOX "X", LOS NIETOS, CALIFORNIA, U. S. A.

PGAC Business Increases 22.5%

Paul Charrin, president of Perforating Guns Atlas Corp., told the company's key management men attending the recent two-day management conference at Houston that PGAC's business in 1956 increased 22.5%, and is expected to continue growing this year. Dr. Hans Nielsen, manager of PGAC's subsidiary, Atlas Deutsch-Amerikanische Oldeldienst GmbH, Kiel, Germany, and W. A. McKay, general manager of Perforating Guns of Canada Ltd., Edmonton, Alta., attended the conference with managers from USA district offices.

J. H. Castel, executive vice president, told the group that PGAC's bullet guns are also in service in Saudi Arabia, and their "Mighty Mouse" permanent completion guns are also serving in the Mexican oil fields.

The recent opening of three new stations was announced: at Crane and Bridgeport, Texas; and at Magnolia, Ark. This brings the total number of PGAC branches to 44. Mr. Charrin told the conference that PGAC's operations in Germany had been extended to two stations; in Venezuela to four branches; and in Canada to four points in Alberta province and two in Saskatchewan province.

Dresser Acquires Transformer Co.

Dresser Industries Inc. has announced acquisition of the Hermetic Seal Transformer Co. Inc., of Garland, Texas. Hermetic manufactures electronic equipment such as transformers and reactors which are used in a wide variety of equipment for communications, radar, sonar, computers, and control systems. Hermetic Seal will become a division of Southwestern Industrial Electronics, another of the Dresser Industries. The products of these two companies are complementary, in that much of SIE's product line requires components such as those produced by Hermetic.

BP Acquires 50 Service Stations

A new step towards implementing the recently announced plans to market BP products in Canada has been completed. This is the purchase from Odilon Chevrier of Chicotoumi, Quebec, of 50 service stations, which were to begin marketing under the BP sign on May 1.

Forms New Atlas Subsidiary

Petro-Atlas Corp., Tulsa, has been formed as a subsidiary of Atlas Corp. to operate that company's oil interests. Dale R. Snow, former vice president of Sunray Oil Corp., is chairman of the new company. Tom Bolack, of Farmington, N. Mex., is president; and Fay T. Anderson, vice president.

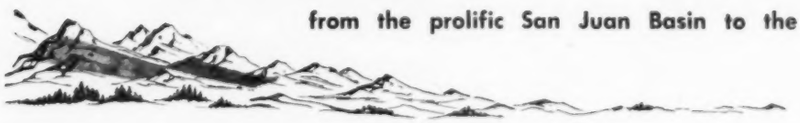
Avondale Anniversary

1957 marks an anniversary for the Harvey "Quick Repair" Yard Division of Avondale Marine Ways Inc. Ten years have passed since 1947, when this division was opened as a one-stop-around-the-clock service station for the marine and oil industries. Harvey business dollar volume has grown from less than one million dollars, in 1947, to approximately 5½ million dollars in 1956.

There were 262 vessels drydocked at the Harvey plant of Avondale in the year 1947. In 1956, the number of vessels increased to 1,287.

POWER FOR THE 1500-MILE PUSH...

from the prolific San Juan Basin to the gas-hungry Pacific Northwest



Construction of this Pacific Northwest Pipeline station, and the sprawling system of which it is part, posed some staggering problems—legal, financial and physical. Feasibility of the project was questioned for years. Some authorities said flatly it couldn't be done.

While the debate raged, however, the Fish Companies proved the feasibility, whipped the unique design problems, built the pipeline and helped form the utilities to take the gas. All with uncommon speed and engineering skill.

The greater scope of the Fish Companies—working together from conception to completion—can be of immense value to industries contemplating gas, oil or chemical facilities.

the fish companies

FISH ENGINEERING CORPORATION
FISH SERVICE CORPORATION
FISH NORTHWEST CONSTRUCTORS, INC.

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is now familiar in the most promising Canadian oil developments. Wherever it is seen, it stands for progressive exploration and technical skill.

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WINNIPEG OFFICE: 810 GRAIN EXCHANGE BUILDING

Baysel

New Light-weight Magnetometer

A "Walking Magnetometer" claimed to be as revolutionary for oil and mineral prospecting as the flying magnetometer, has been announced by the RADIAC CO., INC. Magnetometers are a widely-used oil exploration tool to measure the vertical component of the earth's magnetic field for the solution of a wide variety of geophysical exploration problems, including location of oil-bearing structures indirectly. Magnetometer anomaly studies may indicate and permit mapping of buried contacts between two materials of appreciably different magnetic susceptibilities, ridges, faults, salt domes and other oil structures, etc.

The "walking magnetometer" can be used by a single man (total weight is approximately 12 pounds) and can be operated over areas covered with muskeg, snow and water, where the conventional magnetometer cannot be used with ease. It also can be operated from a non-magnetic boat for prospecting the bottoms of small and large bodies of water, or from a hovering helicopter.

Imperial Oil Expands At Calgary

With consent of the city of Calgary planning advisory committee, Imperial Oil Ltd. will proceed with plans for a $17 million modernization and expansion program at its Calgary refinery. Imperial plans to double the capacity of the existing 8,000 b/d to 8,500 b/d refinery, and install processing units of the latest type.

Birnie Elected Security Vice President

A. M. Birnie has been appointed as executive vice president for Security Engineering Division of Dresser Industries, Dallas. He was formerly vice president and general sales manager, and will continue in his capacity as general sales manager and also assume the responsibility for field engineering activities.

Mr. Birnie joined Security in 1944 as a field engineer. He was named a district manager in 1945, Mid-Continent manager in 1947, and vice president and general sales manager in 1952.

A. M. Birnie

Oil Exploration and Development

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From the Prairies to the Pacific, ***ROYALITE*** is vigorously working in every phase of the oil industry — developing field sources, expanding production and pipeline facilities and serving consumers through a growing service station network. The distinctive ***ROYALITE*** ***"R"*** is fast becoming the symbol of quality petroleum products throughout Western Canada.

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EXPLORATION • GAS & OIL PRODUCTION • REFINING • PIPELINES • MARKETING

J. Ed Warren

Warren Appointed at First National

The First National City Bank of New York has appointed J. Ed Warren a senior vice president. Mr. Warren has directed the bank's petroleum department since his joining the organization, December 1, 1953.

Interest Centers In Virginia Hills

While the Granite Wash oil play in the Red Earth Creek pool has proved disappointing and operations will be suspended without anything conclusive until ground becomes passable again next winter, the new area of interest is Virginia Hills, Alberta, southeast of Sturgeon Lake, where Home Oil and associates have sprung a double discovery in the Slave Point member of Lower Devonian on a big exploration reservation. Work can continue through the summer, and an eight-wildcat program may prove significant.

Houston Nomads visitors: In this photo are visitors at the March meeting of the Houston Chapter of Nomads. Left to right: Steve R. Pounds, Trinidad Oilfield Service, Trinidad, BWI; Martin Mears, superintendent, STA, Turkey; Martin Newell, Tidewater Oil Co., Los Angeles; Virgil Lee, Houston; R. L. (Red) Foster, Socony-Mobile Oil Co., New York; J. C. Robbins, Iran Oil Co., Teheran, Iran.

Alberta To Be Largest Gas Producer

Alexander G. Bailey, Canadian Petroleum Assn.'s gas committee chairman, predicts a vast expansion in Alberta during the next few years. The province will become "the most important and biggest gas-producing area on the continent," he said. "By 1965 we will be selling over 2 billion cubic feet of gas per day outside Alberta."

This expansion, he predicted, will call for expenditures of a total of $450,000,000, exclusive of the millions of dollars being spent by the oil industry in usual exploration and development activities. Of this amount, he estimated equipment to clean gas and extract byproducts will cost $200 million; about $100 million will be needed for drilling and equipping wells to deliver gas, and another $150 million will be spent on gathering systems. He said that the Alberta Gas Trunk Line Co. system, which handles the transportation of all gas as a main transmission system, "will have to be greatly expanded to meet the demands which are now foreseeable."

Markets for Alberta gas, said Mr. Bailey, will be realized all over North America.

Proved natural-gas resources should be at least 30 trillion cubic feet by 1960, as compared with present proved resources totaling approximately 20 trillion cubic feet.

Trans-Mountain To Up Capacity To 240,000 B/D

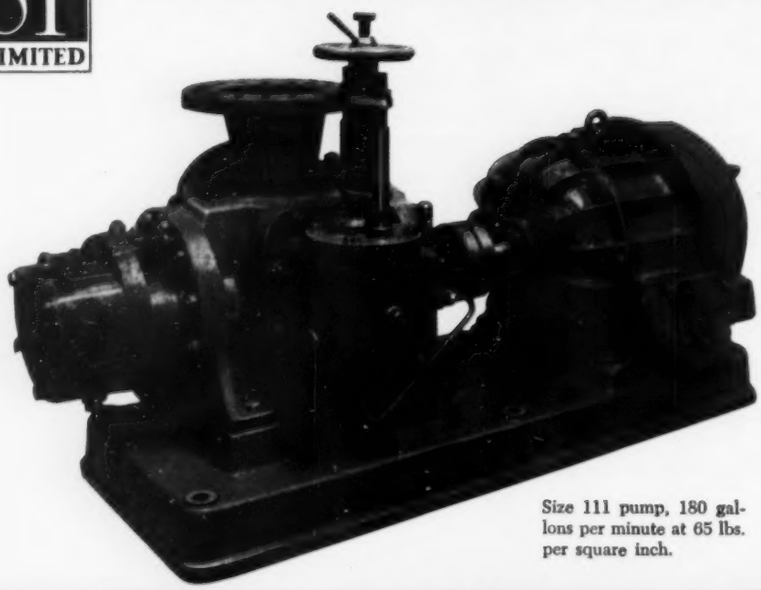
Despite traditional dependence of California on Persian Gulf crude oil, Trans-Mountain Pipe Line Co. officials say there is an unfilled demand for 30,000 to 40,000 b/d of Canadian crude. Argument is supported by April increase in nominations to new high of 44,000 b/d due to more capacity in the pipeline following pumping-station expansion. Further increase is expected later in the summer, when Trans Mountain reaches 240,000 b/d vs. present 195,000 b/d.

Producers PL Federal and Provincial Affiliation

The acquisition of Westspur Pipe Line Co. by Producers' Pipelines Ltd. does not change the basic producer ownership of the system. It creates the advantageous position of having both a provincial and a federal company in affiliation, so that the problem of concurrent jurisdiction is solved. The federal company will handle applications to the Board of Transport Commissioners, while the provincial company will direct those to be heard by the Saskatchewan Conservation Board.

S&P LIMITED

AVIATION SPIRIT PUMP



Size 111 pump, 180 gallons per minute at 65 lbs. per square inch.

Ideal for handling spirit and other volatile fluids. This Screw Displacement Pump is of the all round clearance design and is capable of working with a high suction lift. The flow is practically pulseless and the unit self-priming. The high speed permits direct coupling.

The Pump will stand high shock loads and running for considerable periods against closed discharge without overheating.

Also suitable for heavy fuel and all other petroleum products.

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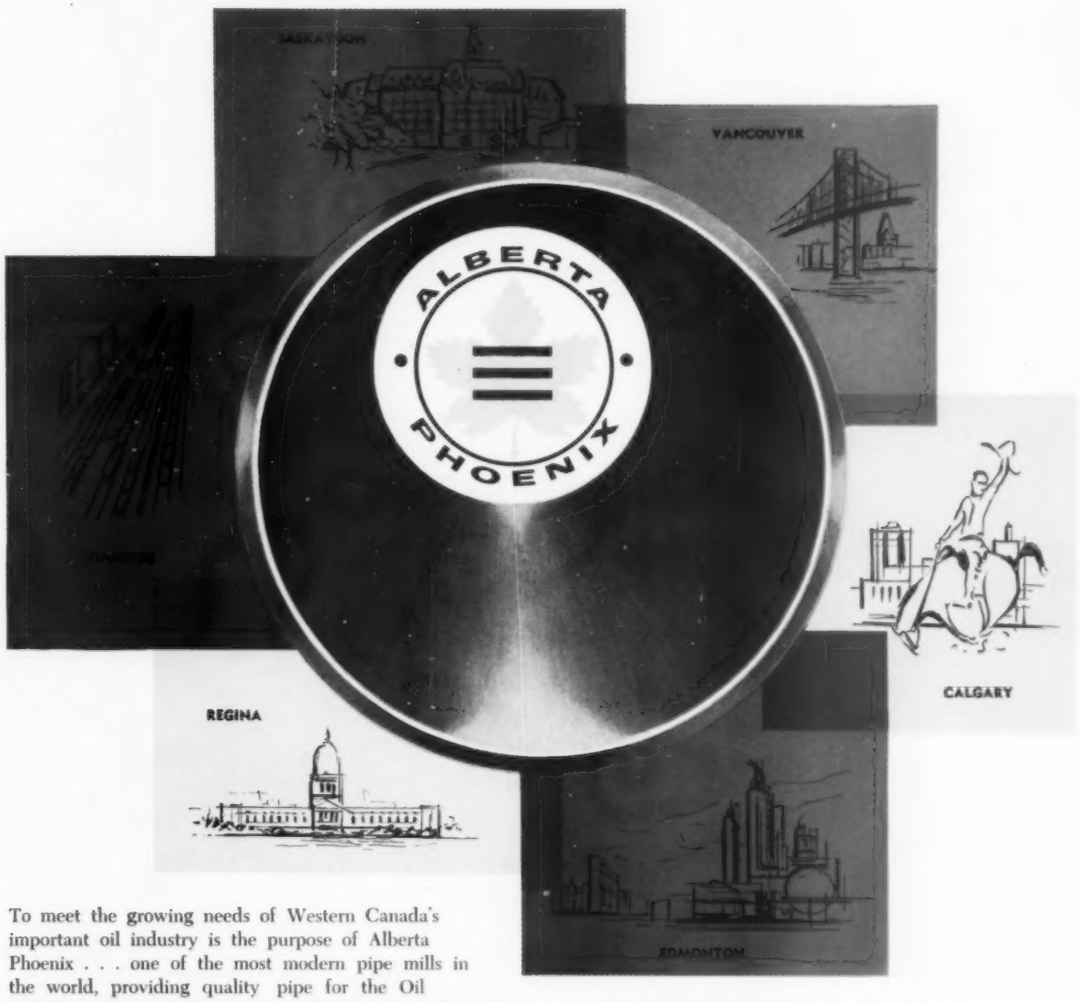
in Western Canada
one PIPE is outstanding



To meet the growing needs of Western Canada's important oil industry is the purpose of Alberta Phoenix . . . one of the most modern pipe mills in the world, providing quality pipe for the Oil and Natural Gas Industry . . . and for every industrial use. Trucks are available to transport pipe direct from plant to stringing along the line, and rail shipments are made over both the Canadian Pacific and Canadian National Railways. This is your guarantee of prompt delivery and lower freight and transportation costs.

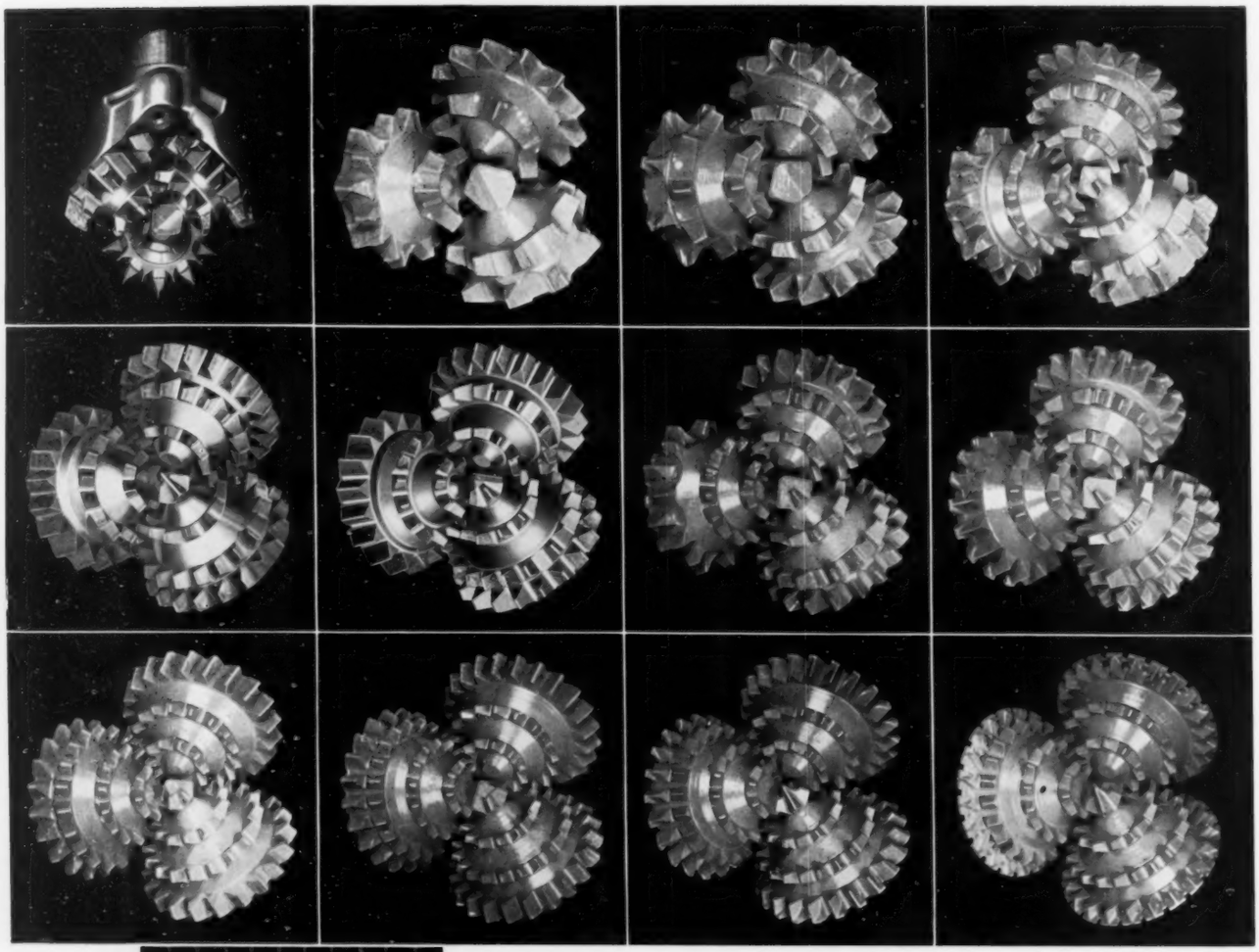
Pipe is available in the size range from 3½" to 12¾" O.D. Thickness from ¼" to ⅜" and lengths up to 60 feet.

AN A.P.I. AUTHORIZED MANUFACTURER

FOR QUALITY - SERVICE
PROMPT DELIVERY - CONVENIENCE
. . . LOOK FOR THE NAME

ALBERTA PHOENIX
TUBE & PIPE LIMITED

EDMONTON ALBERTA



Record Breakers, every one of them!

Every one of these bits have played an important part in Security's rapid climb from 5th to 2nd place in rock bit sales. And each one of them has been setting a record of its own in footage drilled per bit and rate of penetration.

For example, Security S3J bits (upper left corner) were used recently to drill the fastest-drilled medium depth vertical hole in the Seria field of Borneo. Five Security bits were used to drill from 1505′ to 5556′, *an average of 810′ per bit.* In Oklahoma, Security H7 bits (bottom row, 2nd from left) punched through hard Arbuckle limestone for toolpusher Page Arnall of Riceland Corporation to the tune of 53.7′ per bit, an average of 4′ more hole than competitive bits.

Bit records like these are being recorded every day by progressive toolpushers the world over. But records in themselves are not important, rather the lower cost per foot hole drilled by Security bits. You'll know this difference when costs are posted on your balance sheet, the only record that really counts.

If you haven't already, why not give Security a chance to show up on your next record. . . .You'll be glad you did.

End uncertainty in getting the longest tube life per dollar:

... *ask the experts!*

WHATEVER your high-temperature steel problems—heat, pressure, corrosion, oxidation—there's always one tube steel among the Timken Company's 24 different high-temperature analyses that will do the best job. One that will give you the maximum service per dollar and cost per year of required service—the best life/cost ratio.

To find this *one,* right analysis, *ask the experts!*—the metallurgists of The Timken Roller Bearing Company.

These experts are recognized authorities on high-temperature steels, have been for over twenty years. And they're ready to put their experience to work for you. They'll study your particular requirements, recommend the one tube steel to most satisfactorily and economically meet them. Result: you get the longest tube life per dollar.

And you can be assured of uniform high quality in the Timken® steel you get. For the Timken Company controls and guards steel quality from the furnace to final inspection.

Call on Timken Company metallurgists for understanding help in solving your tube steel problems. End uncertainty. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

SICROMO-7

Suggested as a subsitute for steels of the 5.0 per cent chromium type for applications which require increased resistance to corrosion by hot petroleum products.

23 TIMKEN® STEELS FOR HIGH TEMPERATURE SERVICE

Carbon	Sicromo 2	Sicromo 5S	16-13-3
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	25-20
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-12
Silmo	Sicromo 3	Sicromo 9M	35-15*
DM	4-6% Cr.-Mo.	18-8 Stainless	16-25-6*
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti	18-8 Cb	

*Not available as seamless tubing at the present time.

General view of the Timken Company metallographic laboratory where many analyses of steels are viewed under high-power microscopes.

TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

C. A. MEADOWS & ASSOCIATES LTD.

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Specialists In The Design Of

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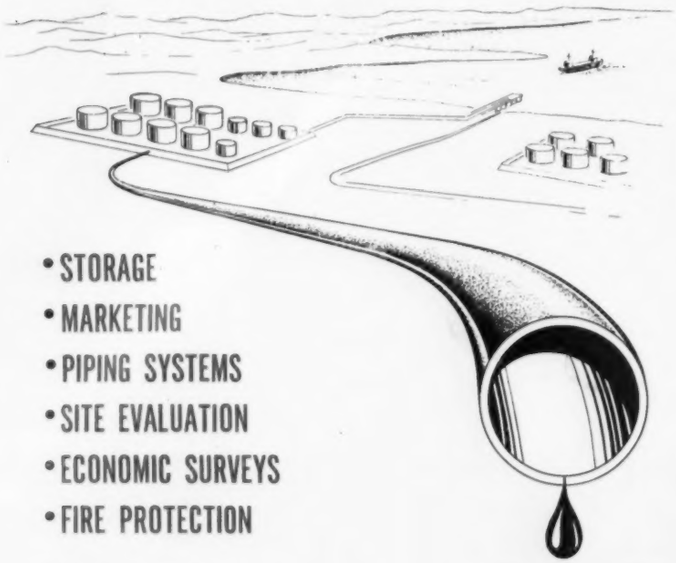

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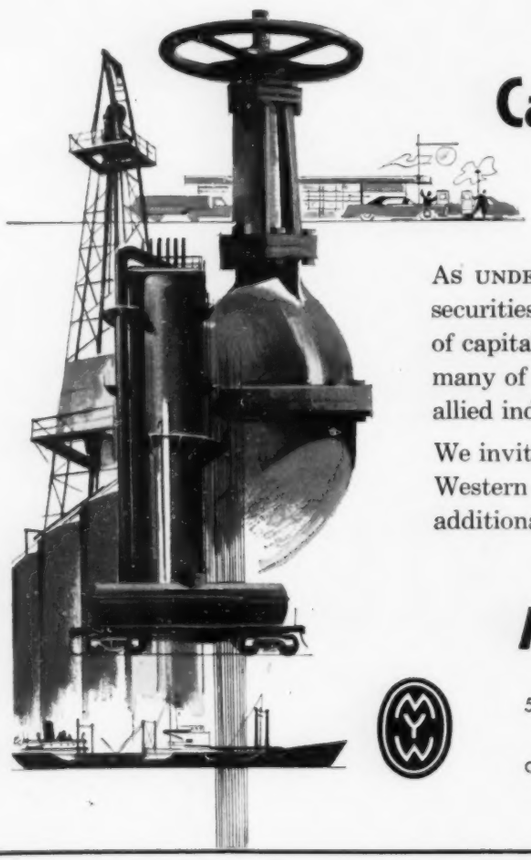

Capital for the Petroleum Industry

AS UNDERWRITERS AND PRIMARY DISTRIBUTORS of corporation securities, we have been identified for many years with the raising of capital funds for leading firms in industry and commerce, including many of the major companies in the oil, gas, pipeline and allied industries.

We invite enquiries from individuals and concerns interested in Western Canadian petroleum development, and who are seeking additional capital funds to establish or expand operations.

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BJ POWER TOOLS

Byron Jackson makes the most complete line of air-powered and hydraulic-powered tools in the industry.

BJ POWER SLIP...side-opening feature allows slip to be placed around pipe or removed without stripping over pipe. Unitized slip assemblies provide quick change to handle all drill pipe and casing sizes from 2⅜" through 7" (13¾" with accessory casing bowl) and up to 300 tons.

BJ POWER TUBING SPIDER...choice of 50- or 75-ton capacity, air- or hydraulic-powered, for 2⅜", 2⅞" and 3½" O.D. tubing. Remote-control foot pedal pressure-raises and pressure-sets slips.

BJ POWER TONGS...BJ Powairmatic (air-powered) Tubing Tong is the world's leading power tong; handles pipe sizes up to 4½" O.D. Hydratorc is hydraulic-powered version, available in two models, "S" (Standard) and "R" (reversible without rolling over). BJ Combination Spinning and Makeup Tong in air or hydraulic models accents safety and convenience by elimination of spinning chain.

BJ RED IRON...

tools for the oil industry

BJ HOOKS

Byron Jackson makes the only *complete* line of hooks for oilfield operations—drilling and producing. BJ developed the Triplex Hook design, now the standard of the industry. *There are more BJ Hooks in use today than any other make!*

BJ HYDRAPLEX HOOKS...new improved design features hydraulic snubber and exclusive nook positioner. Capacities: 100, 150, 250, 350, and 500 tons.

BJ UNIMATIC HOOKS...have BJ "Big Hook" features, yet provide shortest overall length unitized with block. Capacities: 40, 75, 100, 150 and 250 tons.

BJ TUBING and ROD HOOKS...proved in service. Tubing Hooks, 30, 50 and 75 tons; Rod Hooks, 10, 15 and 20 tons.

BJ ELEVATORS

Byron Jackson offers 40 different elevator types in 280 sizes—the most complete line in the industry.

BJ SLIP ELEVATOR-SPIDER...500-ton capacity, for deepest holes and heaviest casing programs. May be used as either elevator or spider.

BJ SLIP CASING ELEVATORS...for 4½" through 13⅜" casing runs. Side door up to 200-ton capacity; center latch, 75-ton capacity.

BJ SIDE DOOR ELEVATORS...available in a complete range of sizes and capacities for drill pipe, casing and tubing; slip type or collar type.

BJ CENTER LATCH ELEVATORS...available in a wide range of sizes and capacities for drill pipe, casing and tubing ...slip type or collar type.

BJ TONGS

Byron Jackson Tongs, available in 14 different types and a range of sizes to handle any size pipe, are especially popular with field crews because of their perfect balance and easy handling. *There are more BJ Tongs in use than any other make!*

Constructed of heat-treated alloy steel and precision machined, BJ Tongs provide longer wear and easier operation.

A feature of BJ Tongs is the superior BJ Gooseneck hanger, which provides quick lateral and longitudinal adjustment for perfect balance.

Standard lubrication fittings are placed in protected recesses, permitting use of large-diameter solid hinge pins not weakened by lubrication holes. Hinge pin holes are flame-hardened to prevent elongation.

OIL FIELD RUBBER PRODUCTS

Byron Jackson's PB Rubber manufacturing facilities have been producing superior oilfield rubber products for more than 25 years. PB does its own compounding and processing, and operates its own laboratory to maintain high quality standards.

PB PROTECTORS AND STABILIZERS...available in Stretch-On and Safe-Lok types. PB Protectors and Stabilizers are easily installed, grip the pipe firmly and provide maximum wear. Both types may be had in oil-resistant rubber. PB Polar Protectors are available for use in severe cold.

PB PIPE WIPERS...flat, oval, tandem—there is a PB Pipe Wiper for every drilling purpose. Flexible webs permit oversize members of the string to be pulled through safely. Available in oil-resistant rubber. Wipers are also available for kellys, tubing and sucker rods.

PB WIRE LINE GUIDES...absorb dangerous whip, lash and traveling waves in the drilling line, prevent excessive wire line wear, uneven line spooling and pile-up, and protect the fast sheave of the crown block. Two types, standard and roller, utilize same principle to damp vibration.

OTHER BASIC BJ EQUIPMENT

- BJ Casing Spider
- BJ Casing Bowl
- BJ Kelly Bushings
- BJ Unitized Hand Slips
- BJ Wall Scratchers
- BJ Casing Centralizers
- BJ Slip Inserts
- BJ Tong Dies
- BJ Centrifugal Pumps
- PB Mud Guns

Ask your BJ field representative today for more detailed information on these and other BJ tools.

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D. M. Curran

Crose Buys Pipe Bending Company

M. J. Crose Manufacturing Co., Tulsa, has purchased the complete facilities of Cinch Pipe Bending Co., of Houston, according to D. M. Curran, president. Cinch products complement the already well-known Crose line with one of the industry's most efficient machines to bend pipe from 6-in. to 36-in. Crose expects to utilize Cinch's excellent facilities for further product refinement and manufacturing diversification.

Crose has been prominent in manufacturing and distributing pipeline equipment and supplies around the world, with 15 foreign representatives including a subsidiary, Crose-Curran Ltd., in Edmonton, Alberta, Canada. The company has pioneered many innovations in the industry, and recently introduced a new line-traveling machine for double coating and wrapping pipe up to 40 in. in diameter—the first machine to do so.

Crose does not plan to move the Cinch operation from Houston, but will continue it as the company's facility and outlet in that city.

$20,000 Dresser Offering

Public offering of $20 million Dresser Industries Inc. 4⅛% subordinated debentures due March 1, 1977 (convertible into the common stock of the company until March 1, 1967) was made (March 13) by an underwriting group headed by Blyth & Co. Inc. The debentures are priced at 100% and accrued interest, to yield 4½% to maturity.

The conversion price is $55 per share of common stock based on principal amount of debentures. A mandatory sinking fund, beginning March 1, 1968, is calculated to retire not less than 60% of the issue prior to maturity. The sinking-fund redemption price is par, and optional redemption prices range from 104⅛% to the principal amount.

The proceeds from the sale will be added to the company's general funds, and will be available for additional working capital and capital expenditures.

Refining Dividends $3.7 Million

Oil refining companies reported cash dividends of $3.7 million in January of this year, compared with $4.2 million in January of last year, the Department of Commerce reported.

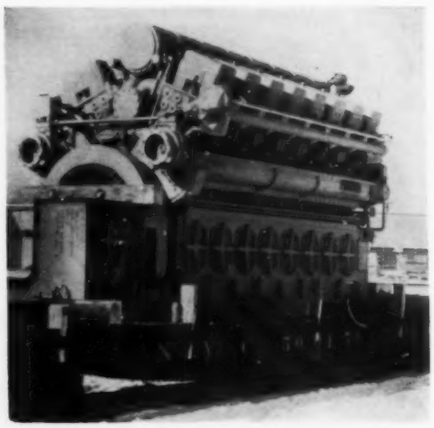
Crown Reserves Administrator Named

As of January 1, A. B. Gibson has been appointed administrator of the Crown Reserve Division, Saskatchewan Department of Mineral Resources, Petroleum and Natural Gas Branch. Duties of this position include the evaluation of crown lands when they are put up for disposition by lease, permit, or reservation.

USA Pipeline Revenues Climb 126½% In 9 Years

Oil pipeline revenues have climbed by 126.5% in the USA in the past nine years, and totaled $679,590,611 in 1956. The number of barrels of crude and products originated on lines and received from connections climbed 89.1%—to $4,381,826.

Much of the increase is due to "a considerable expansion of pipeline network," according to the ICC. The number of lines reporting to the ICC climbed from 45 in 1947 to 68 in 1956, or by 51.1%. The mileage of lines reporting to ICC was 119,298 in 1947, and 140,374 at the start of 1956—a gain of 17.7%.



Westcoast Transmission Co. is rushing completion of its new gas pipeline in British Columbia, and melting winter snows have not helped. All heavy equipment is moved by sled to the respective station sites, including this Nordberg spark-ignition gas engine with built-in gears driving centrifugal gas compressors, which is enroute to the Fort McLeod and Australian station sites. Four engines will be installed in each station. Three additional Nordberg engine units will power the Savona station. Each of the 11 V-type Nordberg Supairthermal 16-cylinder engines is rated at 3,550 bhp at 500 rpm, and will drive a De Laval centrifugal gas compressor.

Meaders and Sparks To Head Nomads

L. B. (Preach) Meaders, president of Halliburton Oil Well Cementing Co., has been named to the chairmanship of the National Board of Regents—NOMADS; and Abbott Sparks, Jr., vice president of Petroleum Engineer Publishing Co., is the new secretary-treasurer of the society.

Messrs. Meaders and Sparks were elected by the regents from the New York, Los Angeles, Tulsa, and Houston chapters. The new officers are the regents of the Dallas-Fort Worth chapter.

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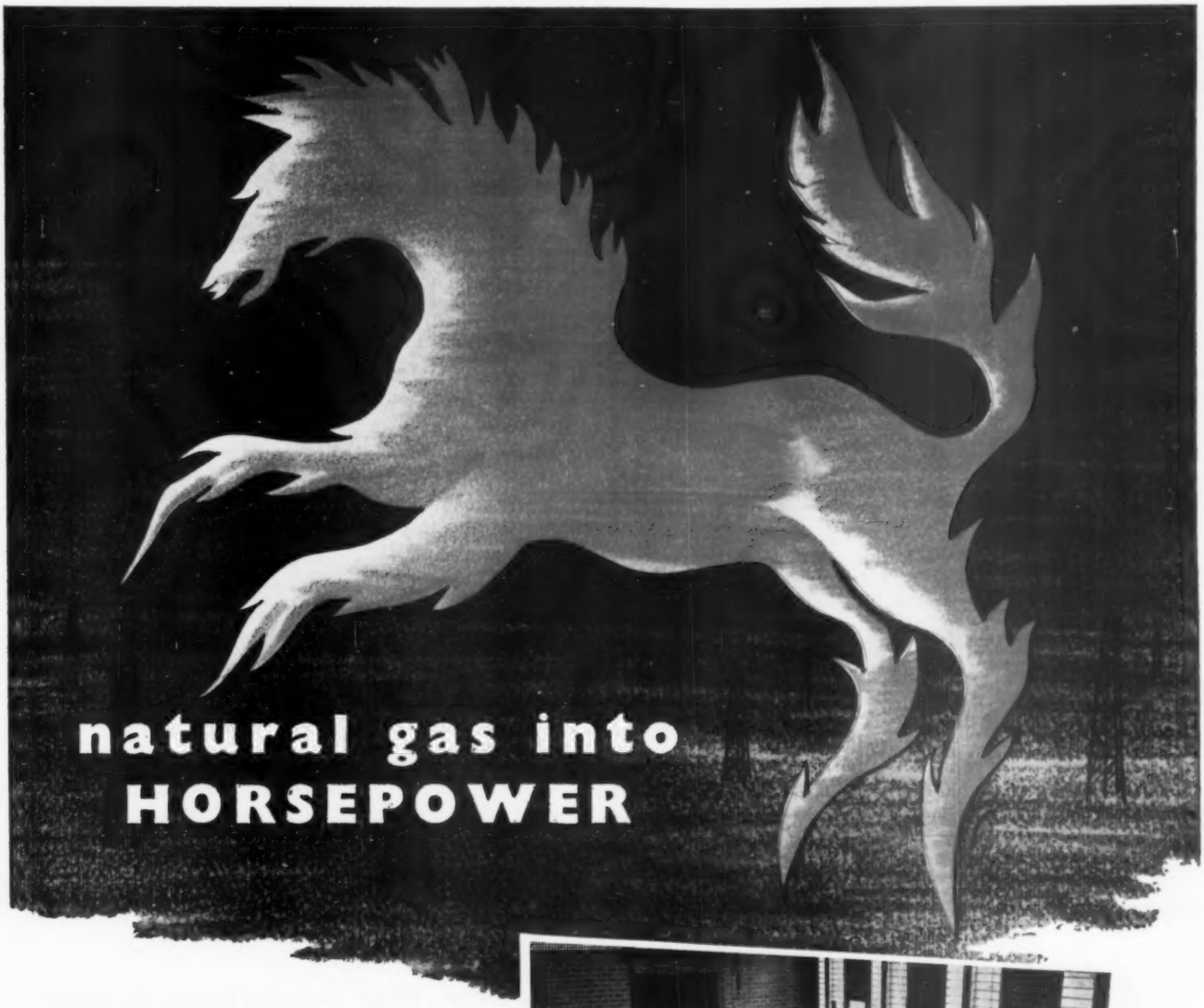

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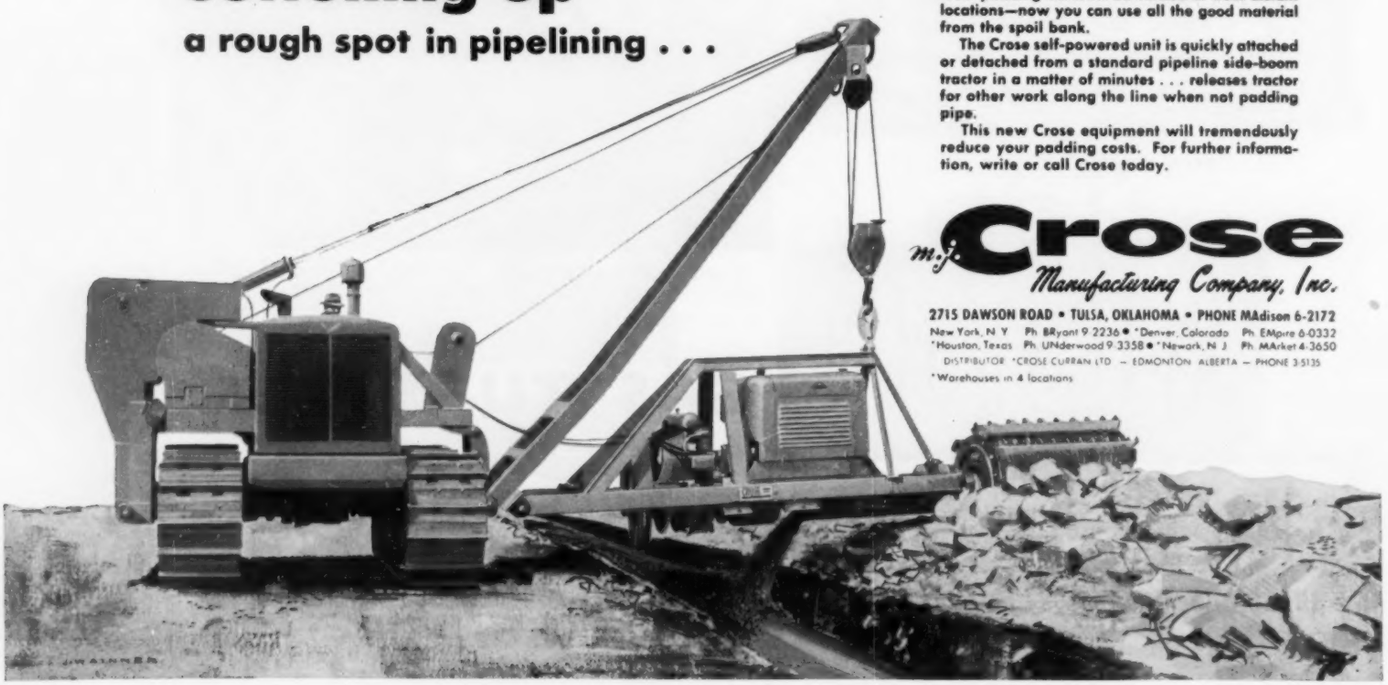
softening up
a rough spot in pipelining . . .



Forward Thinking Crose Engineering has produced another machine to reduce pipeline construction costs! This ditch padder has a screening head and conveyor that completely pads coated pipe with selected soft, rock-free soil. Sharp, pipe-damaging rocks are eliminated. No longer must padding material be hauled in from distant locations—now you can use all the good material from the spoil bank.

The Crose self-powered unit is quickly attached or detached from a standard pipeline side-boom tractor in a matter of minutes . . . releases tractor for other work along the line when not padding pipe.

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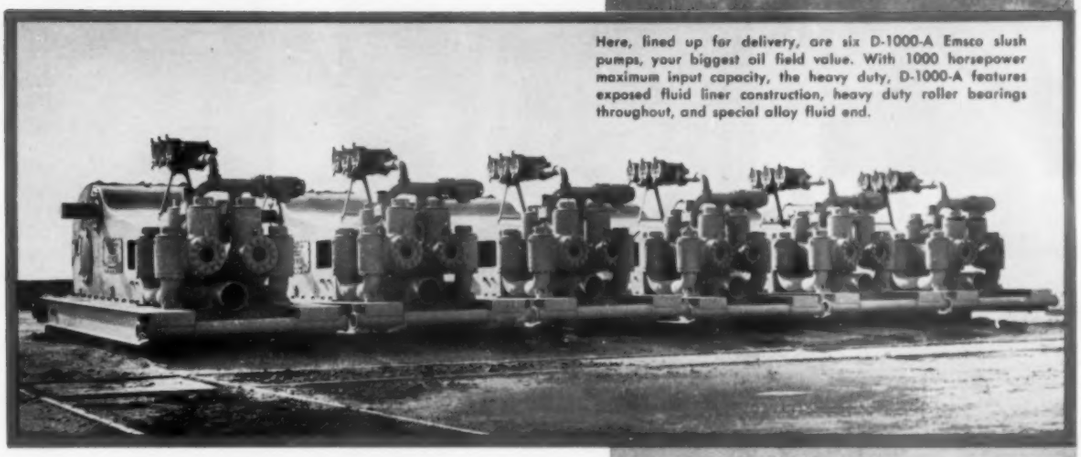

Here, lined up for delivery, are six D-1000-A Emsco slush pumps, your biggest oil field value. With 1000 horsepower maximum input capacity, the heavy duty, D-1000-A features exposed fluid liner construction, heavy duty roller bearings throughout, and special alloy fluid end.

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D-1000-A

Designed and built for extra heavy-duty performance, the D-1000-A slush pump provides the high fluid pressures and volumes you need for deep hole jet drilling. The low weight high performance feature of this pump is made possible by Emsco's fabriform construction. Like all Emsco slush pumps, the D-1000-A is dependable, economical, and easy to maintain. Let your Mid-Continent representative show you how this Emsco pump performs on the deepest holes.

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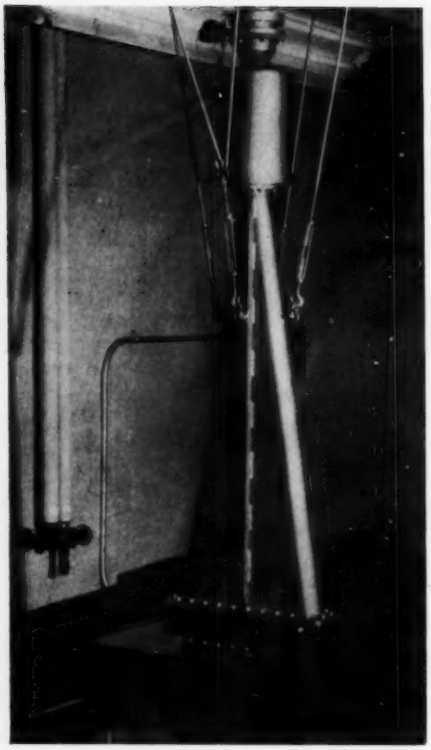
Grover Kilgore

Grover Kilgore Heads PESA

Grover Kilgore, vice president of Halliburton Oil Well Cementing Co., was elected president of the Petroleum Equipment Suppliers Association at its recent annual meeting at Palm Springs, Calif. William T. Powell of Continental-Emsco Co. was elected vice president.

District chairmen for the current year are: H. J. Hagn, Chicksan Co., Pacific; J. G. Seiler, Tube Turns Inc., Eastern; S. P. Wallace, Maloney-Crawford Tank Mfg. Co., Mid-continent; Otto Hammer, Security Engineering Division of Dresser Industries, Southeastern.

The new president of PESA is in charge of sales and advertising for Halliburton. He was born in Duncan and joined the company there as a cement truck driver following his graduation as a geologist from Oklahoma University in 1926. During the past 30 years with the company he has progressed through various jobs with becoming sales and advertising manager in 1947 and vice president in 1950.

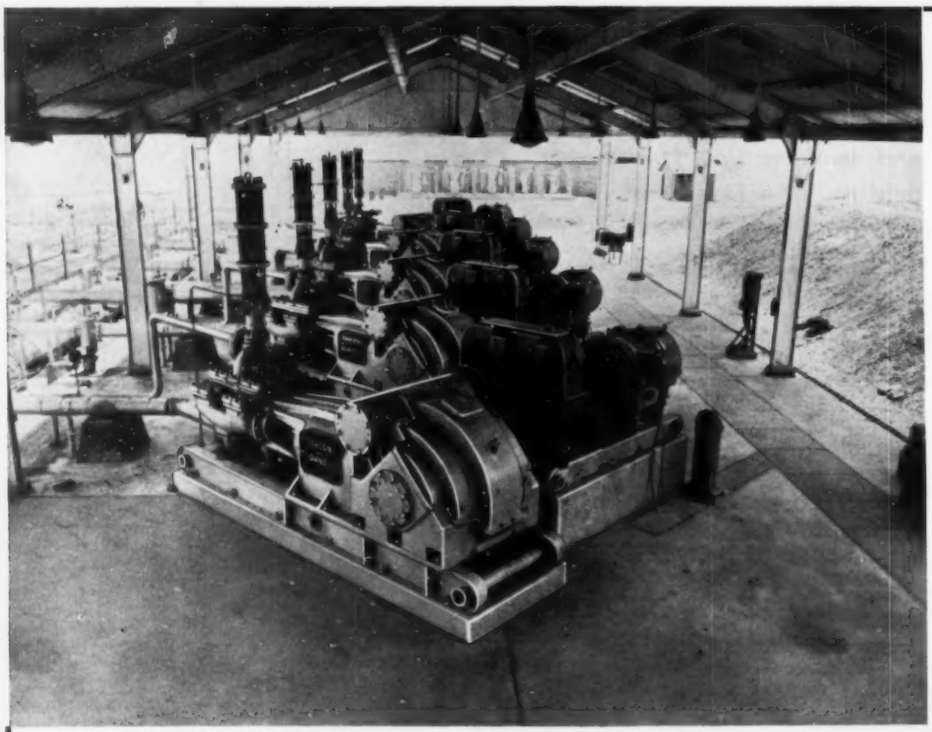


Testing facilities at High Voltage Engineering Corp. plant near Boston, Mass.: Facilities such as these are available on a rental basis to concerns wishing to test the effect of radiation by particle accelerators (Van den Graff) on various products. One outstanding result of irradiation of polyethylene has been increased resistance to heat by cross-linking induced by radiation.

Magcobar Expands Mud Service

Magnet Cove Barium Corp. recently increased its staff and facilities for mud service to offshore drilling operators in the Gulf of Mexico. Seven Magcobar dealers now operate offshore from 18 Louisiana locations, and 3 dealers from 7 Texas locations. Each dealer provides his own transportation equipment.

Magcobar drilling mud is transported to Gulf locations in "Can-A-Mud" containers. These cans contain 50 sacks of weight material, or 5,000 lb each, and can be used to service the hole directly or can be secured to the platform deck to feed the mud tanks. In the bulk storage stations onshore, "Can-A-Mud" containers stand ready as emergency supply.



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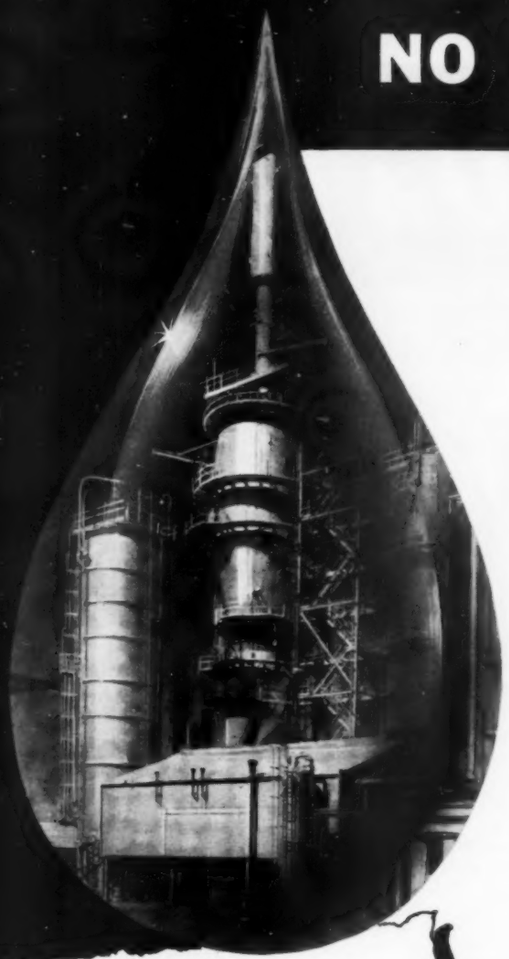

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***CRUDE OIL**

(millions of barrels)

Annual Production	Recoverable Reserves
1952 - 59	1,557
1956 - 120	2,935
1960 - 200	4,000

***NATURAL GAS**

(billions of cubic feet)

Marketed Production	Marketable Reserves
1952 - 70	12,050
1956 - 150	22,500
1960 - 550	26,800

GOVERNMENT OF

ALBERTA

DEPARTMENT OF MINES & MINERALS

HON. E. C. MANNING
Minister

H. H. SOMERVILLE
Deputy Minister

* Taken from the Alberta Government Submission to the Federal Royal Commission on Canada's Economic Prospects.

For complete facts write:

RICHARD MARTLAND
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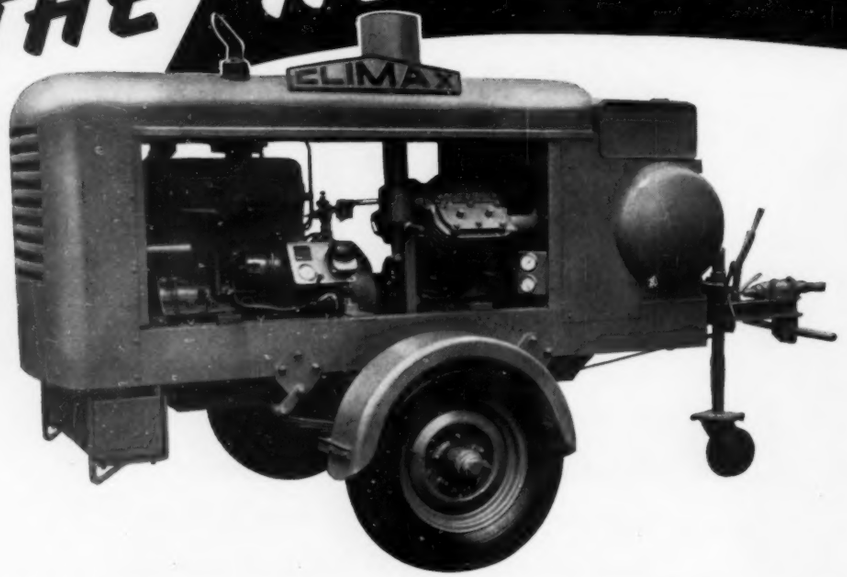

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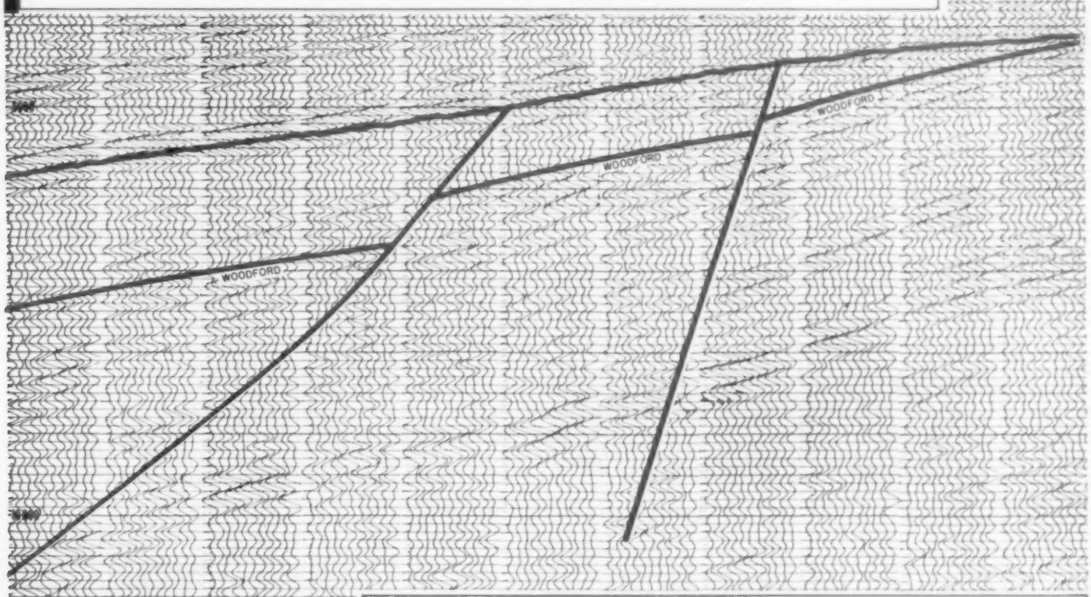

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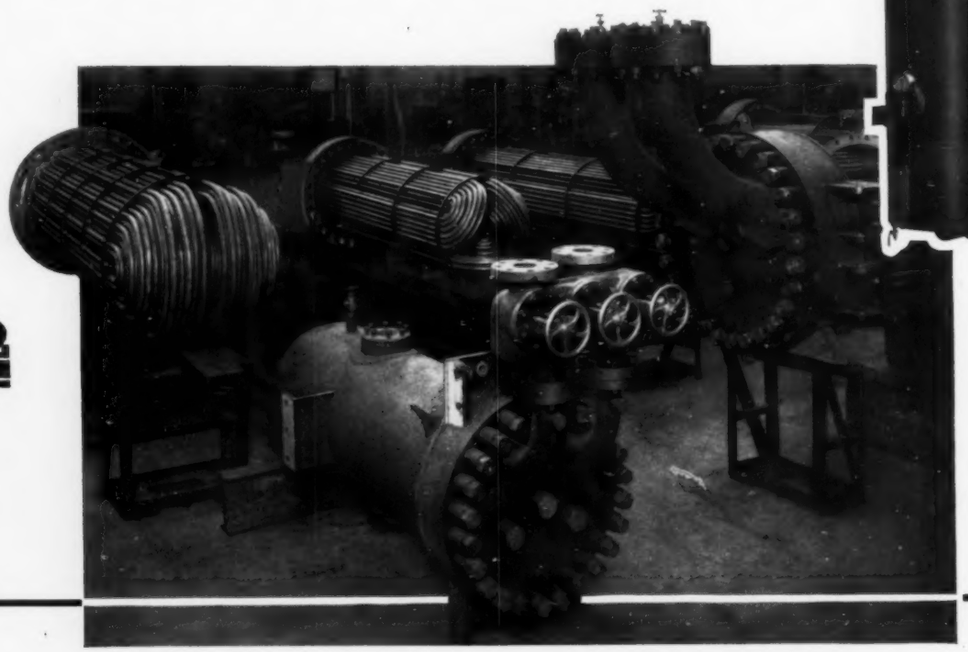

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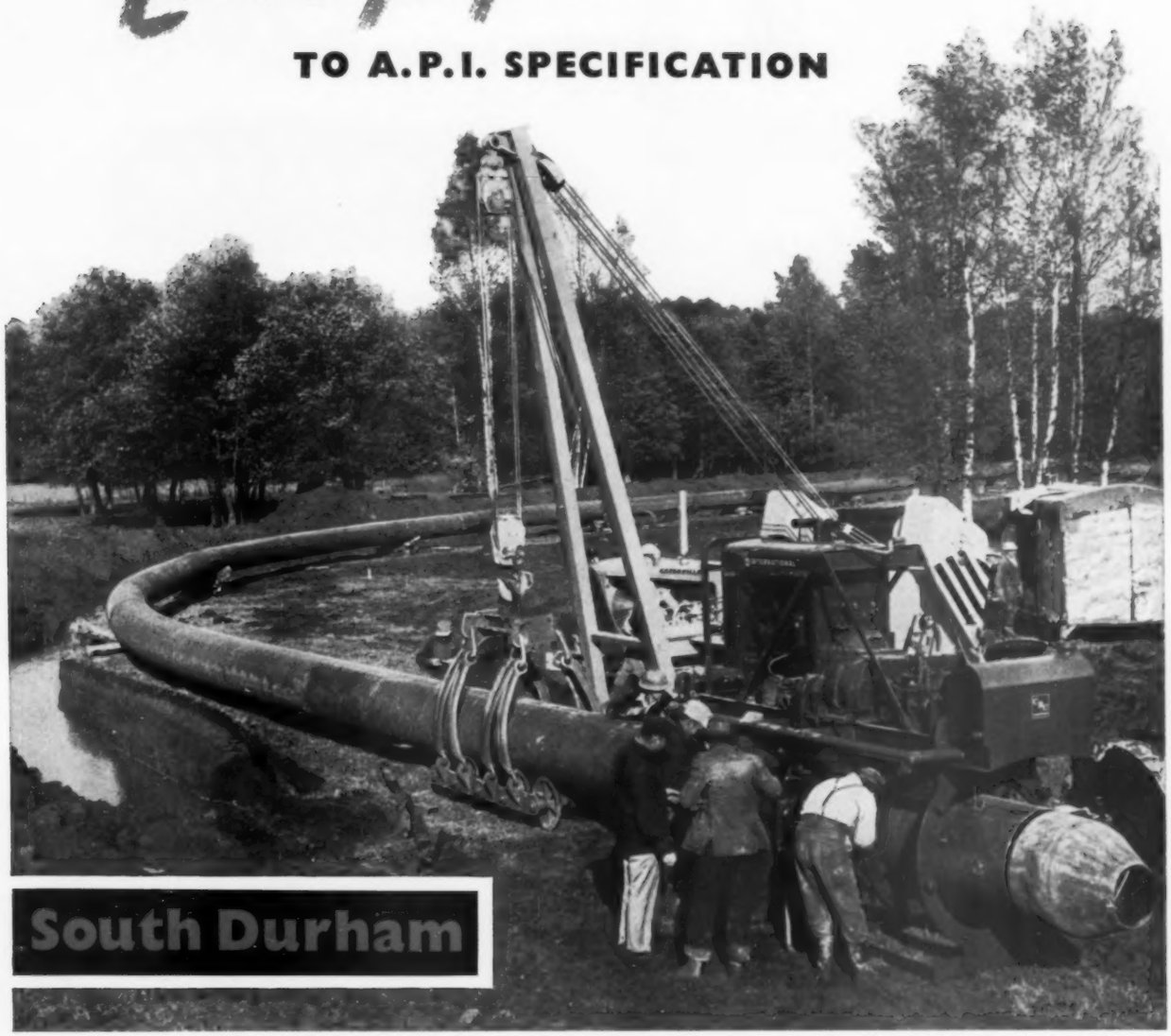

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South Durham Steel Pipes are in use in a number of the world's major oil and gas pipeline installations. They are manufactured by the Automatic Submerged-Arc Electric Welding Process in diameters from 16" up to 40", thicknesses up to $\frac{5}{8}$" and lengths up to 40 feet to conform strictly to the requirements of the A.P.I. 5 LX specification.
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Illustration shows 30" diameter South Durham Steel Pipes in course of installation in the Westcoast Transmission Company's natural gas line from Alberta to Vancouver and the U.S. border.

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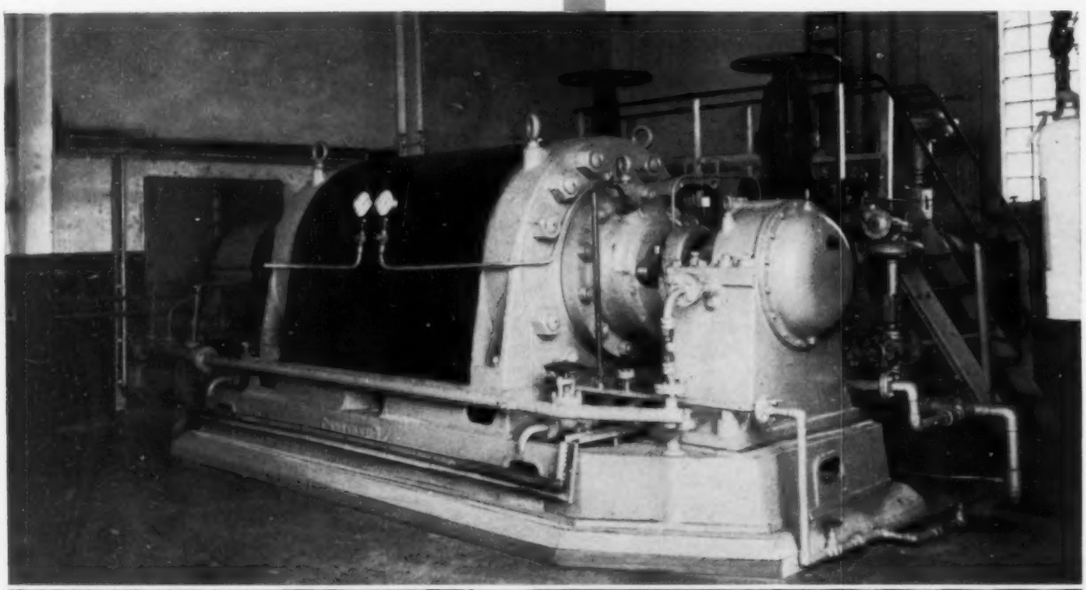
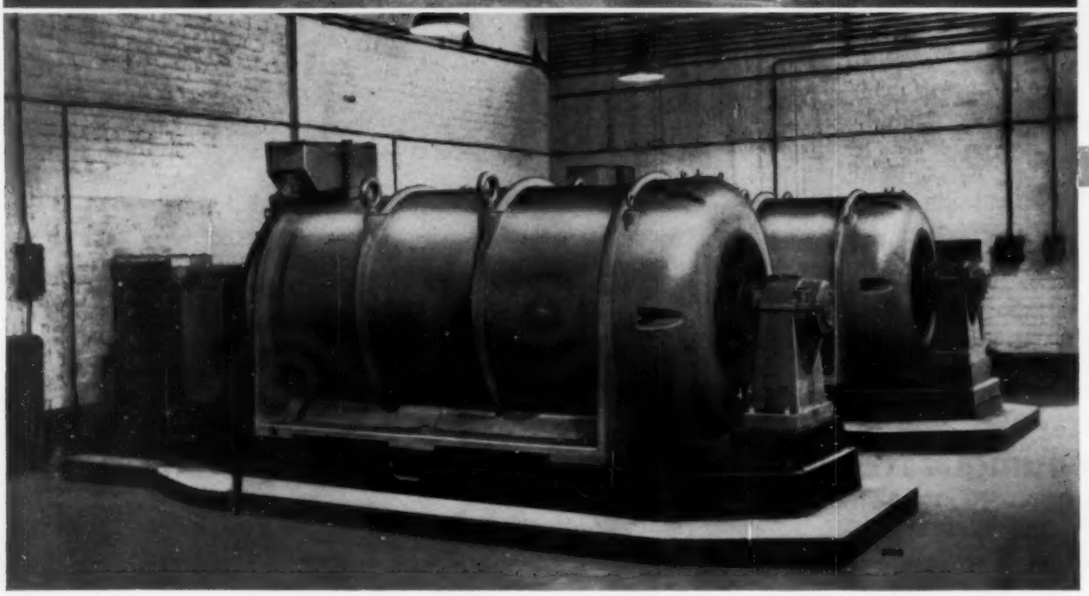


A Mather & Platt Plurovane pump rated to deliver 1760 g.p.m., of crude oil at a head of 2100 feet installed at a Scottish oil pipe-line booster station.



Two 1000 h.p. flameproof motors installed to drive Mather & Platt oil pumps in the famous Oil Pipe Line round Britain.

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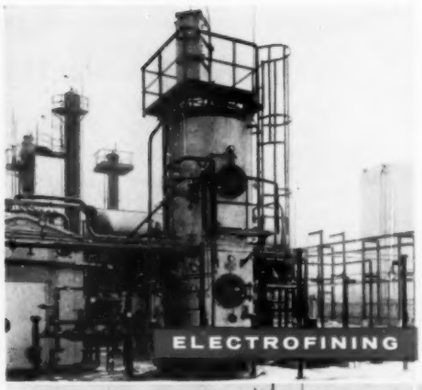

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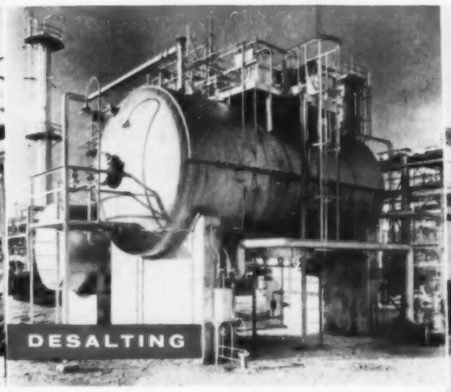

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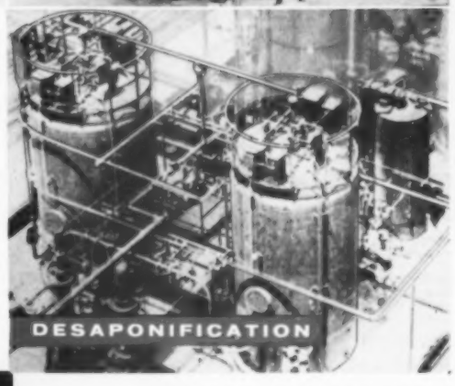

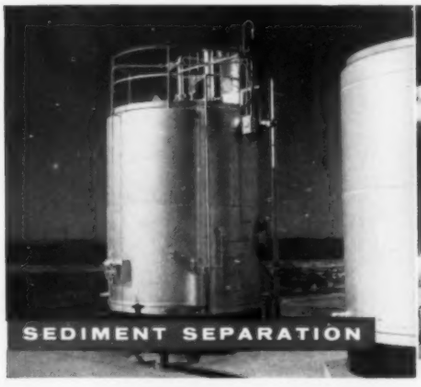

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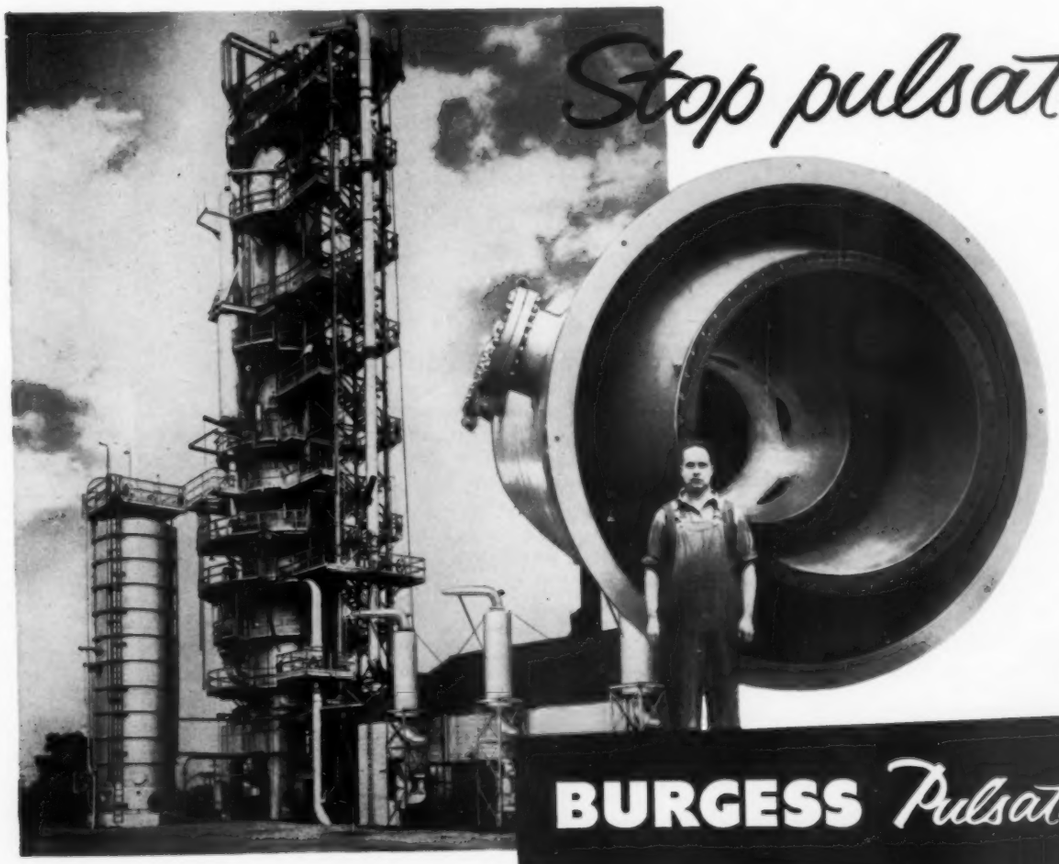

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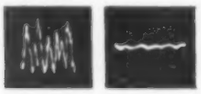

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